DEPARTMENT OF ENERGY'S URANIUM ENRICHMENT PROGRAM

HEARING

BEFORE THE

SUBCOMMITTEE ON ENERGY RESEARCH AND DEVELOPMENT

OF THE

COMMITTEE ON ENERGY AND NATURAL RESOURCES UNITED STATES SENATE

NINETY-SEVENTH CONGRESS

SECOND SESSION

ON THE

DEPARTMENT OF ENERGY'S URANIUM ENRICHMENT PROGRAM

JUNE 24, 1982

Publication No. 97-106

Printed for the use of the
Committee on Energy and Natural Resources

U.S. GOVERNMENT PRINTING OFFICE
11-564 O WASHINGTON : 1982

5311-8

COMMITTEE ON ENERGY AND NATURAL RESOURCES

JAMES A. McCLURE, Idaho, *Chairman*

MARK O. HATFIELD, Oregon
LOWELL P. WEICKER, JR., Connecticut
PETE V. DOMENICI, New Mexico
MALCOLM WALLOP, Wyoming
JOHN W. WARNER, Virginia
GORDON J. HUMPHREY, New Hampshire
FRANK H. MURKOWSKI, Alaska
DON NICKLES, Oklahoma
JOHN P. EAST, North Carolina
JOHN HEINZ, Pennsylvania

HENRY M. JACKSON, Washington
J. BENNETT JOHNSTON, Louisiana
DALE BUMPERS, Arkansas
WENDELL H. FORD, Kentucky
HOWARD M. METZENBAUM, Ohio
SPARK M. MATSUNAGA, Hawaii
JOHN MELCHER, Montana
PAUL E. TSONGAS, Massachusetts
BILL BRADLEY, New Jersey

MICHAEL D. HATHAWAY, *Staff Director*
CHARLES A. TRABANDT, *Chief Counsel*
D. MICHAEL HARVEY, *Chief Counsel for the Minority*

SUBCOMMITTEE ON ENERGY RESEARCH AND DEVELOPMENT

PETE V. DOMENICI, New Mexico, *Chairman*

JOHN P. EAST, North Carolina
DON NICKLES, Oklahoma
LOWELL P. WEICKER, JR., Connecticut
JOHN W. WARNER, Virginia

WENDELL H. FORD, Kentucky
J. BENNETT JOHNSTON, Louisiana
DALE BUMPERS, Arkansas
PAUL E. TSONGAS, Massachusetts

JAMES A. McCLURE and HENRY M. JACKSON are Ex Officio Members of the Subcommittee

PAUL GILMAN, *Professional Staff Member*
ELLIOTT CHAKOFF, *Professional Staff Member*

CONTENTS

STATEMENTS

	Page
Baker, Hon. Howard H., Jr., a U.S. Senator from the State of Tennessee	1
Brewer, Hon. Shelby T., Assistant Secretary for Nuclear Energy, Department of Energy, accompanied by William R. Voigt, Jr., Deputy Assistant Secretary for Uranium Enrichment and Assessment	8
Domenici, Hon. Pete V., a U.S. Senator from the State of New Mexico	1
Glenn, Hon. John, a U.S. Senator from the State of Ohio	3
Grant, Richard L., president, Boeing Engineering & Construction Southeast, Inc	91
Hartig, Dr. E. O., vice president, Goodyear Aerospace Corp	195
McClure, Hon. James A., a U.S. Senator from the State of Idaho	30
McEwen, Hon. Bob, a U.S. Representative from the State of Ohio	6
Metzenbaum, Hon. Howard M., a U.S. Senator from the State of Ohio	5
Rowan, Charles, director, Enrichment Systems, Garrett/AI Research Manufacturing Co	109

ADDITIONAL STATEMENTS

Edison Electric Institute and American Nuclear Energy Council	209

DEPARTMENT OF ENERGY'S URANIUM ENRICHMENT PROGRAM

THURSDAY, JUNE 24, 1982

U.S. SENATE,
SUBCOMMITTEE ON ENERGY RESEARCH AND DEVELOPMENT,
COMMITTEE ON ENERGY AND NATURAL RESOURCES,
Washington, D.C.

The subcommittee met, pursuant to notice, at 9 a.m., in room 6202 Dirksen Office Building, Hon. Pete V. Domenici, presiding.

Present: Senators Domenici, McClure, and Ford.

Also present: Paul Gilman and Elliot Chakoff, professional staff members, and Willis Smith, professional staff member for the minority.

OPENING STATEMENT OF HON. PETE V. DOMENICI, A U.S. SENATOR FROM THE STATE OF NEW MEXICO

Senator DOMENICI. This subcommittee hearing will please come to order. Good morning. Today's hearing is being held to examine the Department of Energy's uranium enrichment program. Testifying before us will be Hon. Shelby T. Brewer, Assistant Secretary for Nuclear Energy of the Department of Energy.

Secretary Brewer will be followed by representatives of the three corporations who are major participants in the Department's enrichment program.

Because in recent years the projected demand for DOE uranium enrichment services has decreased, discussion has resulted regarding the funding and fundamental needs for additional uranium enrichment capacity which was authorized by Congress in 1975.

During the hearing today, I hope we will be able to examine the reasons for the decrease in demand and the options available to us in insuring a cost-effective and reliable enrichment program. Before you testify, Dr. Brewer, I have a statement that our distinguished leader Senator Baker asked be made a part of this hearing record. We will do that without objection at this point.

[The prepared statement of Senator Baker follows:]

STATEMENT OF HON. HOWARD H. BAKER, JR., A U.S. SENATOR FROM THE STATE OF TENNESSEE

Mr. Chairman, I would first like to express my thanks and appreciation to you for having taken time from a very busy schedule to arrange this hearing.

The two reports published recently by the General Accounting Office and the Congressional Research Service raise questions about the future direction of the United States uranium enrichment program, and the appropriate pace of development of the gas centrifuge system currently under construction. As there has thus far been no formal opportunity for the Department of Energy and other interested parties to

comment on the CFS and GAO reports before Members of the Senate, I hope that the hearing today will provide us with a complete and balanced record of the various aspects of this issue.

The desire for a sound, well-rounded energy base in this country, a belief in the need to maintain American leadership in basic energy technologies, and a concern for continued private sector confidence and participation in this and other vital research and developemt programs are the elements, Mr. Chairman, that from the basis of my interest and concern over the furure of the Gas Centrifuge Enrichment Program (GCEP).

First, I am deeply concerned, as is everyone in this room, that the United States have a healthy, secure energy base. That base needs to include safe, economic nuclear power, and technological leadership in all phases of nuclear engineering to assure energy independence in the years ahead. Despite its current trials in this country, I continue to believe that nuclear power is a vital and indispensible element in our overall energy equation, and the GCEP modernization of our uranium enrichment capability is clearly linked to the future of the nucler power program in the U.S. Our gas centrifuge technology is, by all accounts, the most advanced proven enrichment technology in the word offering both improved economics and production reliability. Present enrichment technology is heavily dependent on electrical energy, the cost of which comprises 50 percent of the total cost of the service. The gas centrifuge uses one twentieth of the energy needed for diffusion enrichment of uranium. And it thereby largely secures a permanent disengagement of energy costs from enrichment costs, a clear potential advantage in the years ahead which I hope would be considered carefully in these proceedings today.

Secondly, Mr. Chairman, I believe it is essential that this country support development of frontier technologies in whatever the field of endeavor. We have lost ground in too many areas of technology where we were once at the forefront. Too often, we have slipped and others have stepped in to lead the field. I find it difficult to accept the notion that this country cannot and should not support the research and development work necessary to keep ahead of a very serious economic game. On the contrary, we cannot afford to cede the territory in that effort, and we have lost ground in enrichment services. The United States once held 100 percent of the market in uranium enrichment. That share now stands at 35 percent. Where we once led the world, we now trail the market. To be sure, there are a number of reasons for that loss of leadership. Competitors have emerged and other nations have grown wary of our reliability as a supplier of enriched uranium fuels. Security and diversification of supply have therefore contributed to the decline in our share of the enrichment market. But the policies of the the new Administration, coupled with continued American technological leadership now present us with the opportunity to redress that situation.

Third, Mr. Chairman, I fear we may be in danger, yet again, of further undermining private sector confidence in large-scale, government initiated research and development in high technology projects. Should we lose that confidence in still another field of endeavor, Mr. Chairman, it would be a serious loss indeed, because by in large, I do not believe the government is best at the vast array of technical and engineering judgments so vital to the success and economical execution of such high technology projects. We seek massive private investment and long-term contractual commitments from industry, and then back away from the inevitable risks and necessary expenditures involved. The record in energy technology alone amply demonstrates the increasing reluctance of the private sector to commit long-term resources to such development programs. Investment in the back end of the nuclear fuel cycle, industry participation in the LMFBR and other advanced reactor programs, industry involvement in the fusion development program—all have fallen afoul, to a greater or lesser extent, of government vacillation and incertitude.

The companies involved in the Gas Centrifuge Enrichment Program have invested many years in that program, have developed a wealth of expertise and exerience in all aspects of centrifuge enrichment, have thousands of employees devoted to its success, and have developed an intricate supporting network of suppliers and vendors around the country. Such is the investment we begin to cast in doubt. We must take careful pause to consider how soon these human and institutional resources could be resurrected should we put GCEP on the shelf for the sake of achieving temporary, short-term budgetary advantage.

Mr. Chairman, the issues to be considered here today raise many questions and suggest a number of options. There are many uncertainties in attempting to forecast what the world energy picture will be in thirty years or even ten years from now. There are uncertainties over the price of uranium; there are uncertainties over the demand for nuclear fuel and hence enrichment services; there are uncertainties

over the costs and schedules for development of alternative enrichment technologies. All of those numbers, none of them perfect, have question marks hanging over them. It is important and appropriate to pose the questions, and it is equally important to be careful and judicious in drawing conclusions from the answers that have thus far been presented, or may be presented here today. Much has changed around us in recent years, and it is certain that much will change again.

A few facts are clear, however. What we do know is that we at present operate an expensive, energy-intensive enrichment process, and we have 35 percent of the world market. We know that we have under development the most advanced proven enrichment technology in the world. It works, and is on schedule for first operation in 1989. We are assured of its economic performance and its production reliability. We also know that future advances might be made in enrichment technology. We are also working on advanced isotope separation, have examined three competing systems, and at present are further developing one of those systems. That technology may be available by the mid-1990's It may not be.

Some have raised the question of whether all or part of the Gas Centrifuge Enrichment effort might be postponed or stretched out. The suggestion has even been made that centrifuge technology may be unnecessary and too expensive, that we should rely on diffusion technology until advanced isotope separation technologies become available. One technology is expensive, the other is unproven.

Mr. Chairman, distinguished and expert Members of the Committee on Energy and Natural Resources, we all know well what is at stake as we examine the issues today. I hope and trust that this hearing will provide a thorough review of the options before us, will complete and balance the record insofar as that is possible, and will allow us to proceed with new confidence in a program that will assure U.S. leadership and capability in a fundamentally strategically important area of energy technology.

Thank you, Mr. Chairman.

Senator DOMENICI. The distinguished senior Senator from the State of Ohio, Senator John Glenn, has a statement which he has prepared to be made a part of the record, as does the junior Senator from Ohio, Senator Metzenbaum, and Congressman Bob McEwen. Those statements will be made a part of the record at this point.

[The statements follows:]

STATEMENT OF HON. JOHN GLENN, A U.S. SENATOR FROM THE STATE OF OHIO

Mr. Chairman, thank you for the courtesy of granting my request to testify before this subcommitee on a most critical subject—one that not only has profound economic implications for my home State of Ohio, but is of importance for the national security of the United States.

Since the inception of the Atoms-for-Peace Program in 1953, the Uranium Enrichment Program has played an important role in aiding the expansion of our nuclear industry and helping our nuclear nonproliferation effort. The uranium enrichment enterprise collected over $1.25 billion in revenues in fiscal year 1981 and expects revenues during fiscal year 1982 to exceed $1.8 billion. Nuclear enrichment services have helped us to reduce our enormous trade deficit over the years—more than $3 billion in total sales, including some $539 million in fiscal year 1981 alone. It has played a vital role in the national security of the United States and the free world.

It is vitally important for the United States to remain a principal supplier of foreign enrichment needs for several reasons. First, we will be able to exert maximum influence on foreign users to cooperate in our nuclear nonproliferation objectives. Second, we will continue to reap the benefits of helping to reduce our balance of payments deficit. Third, we will be able to optimize the use of our available capacity in order to minimize the cost for all customers, both domestic and foreign.

Key to this strategy is the timely completion of the Portsmouth Gas Centrifuge Enrichment Plant which will provide an additional 13.2 million SWU's upon its completion. GCEP will provide further assurance to our domestic and foreign customers that the United States is the most economical and most reliable source of enriched uranium. GCEP is twenty-times more energy efficient than the old gaseous diffusion process. Construction will avoid over $3.5 billion in construction of electric generating plants and save the energy equivalent of 1.5 billion barrels over its lifetime relative to operating a similar capacity using diffusion technology.

In addition to these benefits, there is the matter of jobs. Some 10,000 people are employed in the operation, maintenance, and support of the three diffusion plants. There are also more than 3,000 people engaged directly in the design and construction of the Portsmouth GCEP. Some 41 states have activities associated with this project. At the end of my statement, I have included the list of states with GCEP contracts and the value of those contracts as of March 12, 1982.

DOE analyses has shown that it is desirable to build GCEP as quickly as possible, yet GCEP is under attack from certain quarters. We must modernize and expand our enrichment capacity or risk losing our position as a reliable supplier of competitively priced enrichment services. Centrifuge technology has been well-tested and is the result of over twenty years of research. To delay implementation of this technology in favor of advanced isotope separation which has thus far been tested only on a laboratory scale, is to risk putting the United States behind its competitors.

Mr. Chairman, all of us are aware of the reports by the General Accounting Office and the Congressional Research Service concerning the GCEP project. The GAO's pessimistic view of this project stems from its analysis of nuclear demand indicating that by the year 2000 only 217 gigawatts of nuclear generated electricity will be available for servicing by the U.S. government's nuclear enrichment program. While the GAO has made a compelling case in favor of its figure on demand, I believe there are a number of other elements that need to be taken into account in any decision concerning the future of GCEP. First, and foremost, is the uncertainty surrounding, not only the question of demand, but the question of the viability of advanced isotope separation. As the GAO report says, "constructing the plant (i.e., GCEP) is economical if events cause a sudden increase in the demand for nuclear power or if DOE's efforts to develop advanced isotope separation technology fail." The GAO also says that Congress shoud take other considerations besides demand into account in making judgements about GCEP. We know that additional enrichment capacity is going to be needed sometime in the future; we know that U.S. leadership in nuclear nonproliferation demands that the U.S. be percived as having the capability of providing nuclear enrichment services to other countries; we know that cancellation of GCEP would not only be highly socially disruptive at this point, but would probably create a situation where the cost of termination might well exceed the cost of continuation in fiscal year 1983.

Mr. Chairman, I have read the DOE testimony that is going to be presented this morning, and I believe they have made an effective rebuttal to some of the claims contained in the GAO report. On nonproliferation grounds alone we should be wary about abandoning GCEP in favor of advanced isotope separation even if the later works.

At this point Mr. Chairman, I would like to take the opportunity to address a broader issue than GCEP associated with our nuclear enrichment enterprise.

Mr. Chairman, the costs of the enrichment program, along with the rapidly changing domestic and foreign prospects for nuclear reactors and the business-type nature of the enterprise, calls for a financial system which provides for more management flexibility than is offered in the usual authorization and appropriation cycles.

This increased flexibility can be provided through establishment of a Uranium Enrichment Revolving Fund which should result in greater overall economy and efficiency. I have introduced a Senate bill, S. 350, to create such a fund, and I know that Representatives McEwen and Lujan have introduced similar bills on the House side. The establishment of a revolving fund would aid marketing initiatives, and would further U.S. nonproliferation objectives and improve the U.S. balance of payments. It would also provide some degree of stability to the uranium enrichment enterprise. It is my view that the fund will aid our domestic industry, as well as our competitive posture with respect to foreign uranium enrichment sales.

Finally, I would like to say a work about the current effort by the U.S. to bid on entering into a joint venture with Australia to build a uranium enrichment plant in that country. In connection with this proposal, DOE is examining various ways in which all or part of the nuclear enrichment enterprise could be converted to private ownership. I wish to point out that private ownership of enrichment technology raises some serious questions involving national security and our nonproliferation effort that require the most careful scrutiny. It is important that we obtain a clear understanding and commitment from the Administration that GCEP will be completed in a timely fashion, regardless of the outcome of current United States-Australian discussions. This should be made a necessary condition for Congressional support for such an international joint venture.

In conclusion, I will say simply that the U.S. needs both the GCEP program and a uranium enrichment revolving fund so that it can move forward with confidence

into the next phase of o[illegible]ional nuclear enterprise, including the provision of additional energy and en[illegible] national security.

Thank you.

GCEP impact by State

State:	*Contract Value ($1000)*[1]
Alabama	$17,880
Arizona	2
California	249,419
Colorado	2,311
Connecticut	5,624
Delaware	7
District of Columbia	651
Florida	1,042
Georgia	14,864
Illinois	8,408
Iowa	168
Indiana	2,874
Kansas	2
Kentucky	126
Maryland	5,329
Massachusetts	2,461
Michigan	5,686
Minnesota	2,595
Mississippi	17
Missouri	1,989
Nevada	3
New Hampshire	4
New Jersey	3,041
New Mexico	322
New York	4,706
North Carolina	8,496
Ohio	403,548
Oregon	8
Pennsylvania	39,486
Rhode Island	1,163
South Carolina	60
South Dakota	2
Tennessee	306,461
Texas	40,527
Utah	10
Vermont	24
Virginia	30,527
Washington	87,896
West Virginia	2,027
Wisconsin	583
Wyoming	7
Total	1,250,292

[1] Contracted dollars are represented to the subcontract of the prime contract level.

STATEMENT OF HON. HOWARD M. METZENBAUM, A U.S. SENATOR FROM THE STATE OF OHIO

Mr. Chairman, we are today producing our enriched uranium by means of gaseous diffusion, an obsolete technology. Gaseous diffusion is the most energy intensive of all enrichment technologies. It is extremely costly to operate. And in 1978, Congress decided that the centrifuge technology, which uses 95 percent less electricity, should be developed commercially to conserve energy, reduce enrichment costs, and insure that the United States retains technical superiority in this field.

When Congress decided to go forward with GCEP, the United States controlled more than 80 percent of the international enriched uranium market. Now, just four years later, our share has dwindled to thirty-five percent.

We have lost fifty-five percent of this multibillion dollar industry, Mr. Chairman, because the United States is no longer perceived as a reliable supplier of enrichment services. Foreign nations have seen Congress vacillate every year about whether or not we should continue constructing GCEP. They are aware of the $150 million cut Congress voted in 1979—a cut which will delay GCEP's completion date by a full year.

Foreign purchasers have turned to the French, the British German consortium and even to the Soviets for enriched uranium. And during all of this Congress continues to waver on GCEP while the delivered price of enrichment services from our diffusion plants goes through the roof.

To date the United States has lost tens of billions of dollars in long term enrichment contracts. But we have lost much more than the international trade that would have helped our balance of trade deficit. We have also lost the ability to control the use of enriched uranium by foreign nations and to prevent the proliferation of nuclear weapons.

According to the Department of Energy, we still have 100 billion in long term contracts remaining. But if the Congress fails to go forward with full funding to complete GCEP on schedule, we will seriously jeopardize those remaining contracts over the next fifteen years. In fact, several domestic utilities have already told D.O.E. that they are willing to contract with the French if the future economies of U.S. enrichment services do not improve.

And the outlook for improvement is certainly bleak as long as we continue to rely solely on diffusion technology because the price of electricity will continue to rise.

If we go forward with GCEP, the delivered price of enrichment services will go down and the United States will be able to regain a portion of the international market we lost during the past decade.

If we cut funds for GCEP, thereby delaying or terminating the project, we will be left with nothing but the diffusion plants, and we will simply price ourselves out of the market.

This is the choice the Congress faces.

Demand for enrichment services will not go away. It will simply go elsewhere. The General Accounting Office has issued a report recommending that Congress terminate or delay GCEP. That is one policy option. But I think this hearing will show quite clearly that the G.A.O. reached its conclusion by using erroneous cost data by making biased and undocumented assumptions, and by failing to weigh several critical cost factors and budgetary impacts.

I am confident that once the subcommittee examines the G.A.O.'s assumptions, it will realize that to follow this option is not in our Nation's best interest and that we should move forward to complete the project.

STATEMENT OF HON. BOB MCEWEN, A U.S. REPRESENTATIVE FROM THE STATE OF OHIO

Mr. Chairman, Thank you for your courtesy in giving me the opportunity to testify before this subcommittee on a most crucial subject. I am glad to be here today to share with you and the other members of this committee my views on uranium enrichment. I am going to focus on two points—one, the importance of completing the Portsmouth Gas Centrifuge Enrichment Plant in a timely manner, and two, additional steps that should be taken to permit long range planning of uranium enrichment activities.

The assured supply of enriched uranium from the Department of Energy's diffusion plants has been an essential element in the development of nuclear power in this country. In addition to supplying 100 percent of our domestic needs for enriched uranium, the U.S. Government filled virtually the entire demand for enrichment outside of the Soviet bloc until the late 1970's. To date, foreign sales of enrichment have totaled over $3 billion. However, doubts about the reliability of the United States as a supplier of enriched uranium have recently caused foreign customers to cancel hundreds of millions of dollars worth of enrichment contracts with Department of Energy in favor of European suppliers. Presently, the United States supplies only 35 percent of foreign enrichment demand. Unless the United States can demonstrate its commitment to be a reliable supplier of enrichment services, additional foreign and domestic enrichment contracts may be lost to foreign competitors. Construction of the gas centrifuge plant is the only basis on which DOE can accept new contracts for enrichment services. It is a key element in re-establishing the U.S. as a reliable international supplier of enriched uranium.

In addition, the Department of Energy currently holds long-term contracts to supply separative work well above the capacity of its diffusion plants, some 295 contracts with U.S. and foreign utilities, extending beyond the year 2000, with a total

value in the neighborhood of $75 billion. DOE must also supply all of the requirements for government and defense needs. Although some of the contracts are to supply nuclear power plants whose construction may be delayed, all reasonable forecasts of nuclear power growth indicate a need during the early 1990's for enrichment capacity in excess of the diffusion complex. These demands for enrichment can be met most economically by keeping the Portsmouth centrifuge plant on schedule for operation in 1989.

There are additional, perhaps even more compelling reasons to complete the Portsmouth plant as rapidly as possible. Enrichment by the centrifuge process requires 5 percent of the electric power consumed in the diffusion process. Building the Portsmouth plant is fully justified on the basis of the energy that it could save if used to replace the equivalent output of a diffusion plant. The equivalent of 150,000 barrels of oil per day, or some 1.5 billion barrels over its lifetime would be saved. Additionally, over $3.5 billion in construction of electric generating plants would be saved.

These tremendous energy savings would result in other substantial cost savings as well. GCEP leads to a production unit cost one-third that of the diffusion process by 1996. Lower costs for uranium enrichment would be passed on to consumers in the form of lower electricity rates. It would also help the United States to compete for foreign sales of enriched uranium and hence, help our balance of trade.

Additionally, there is the matter of jobs. Over 3,000 people are engaged directly in the design and construction of GCEP. These numbers do not include subcontractors who supply the components, materials, and services, some 5,000 to 7,000 people, nor do they include the support activities brought about not only in my home state of Ohio, but also in the subcontractors states, some 41 states in all. This project is national in execution as well as purpose.

Another important consideration is this nation's well-established goal of nuclear non-proliferation. We must remember that one of the few options left to the U.S. in influencing other countries' nuclear programs is our capacity and ability to sell enrichment services at a reasonable and competitive price. If we do not modernize and expand our enrichment capacity, we risk losing our position as a reliable supplier of competitively-priced enrichment services. If we lose that position, we further diminish our influence in this important field.

Uranium enrichment is nearly a $2 billion per year business operated by the Department of Energy. I use the term business loosely here, because while effective operation of the enrichment enterprise requires business decisions regarding production and inventory management, capacity expansion, marketing, and technology development; the financial constraints imposed by the yearly Congressional appropriations cycle preclude the management flexibility and long-range planning necessary to operate in a business-like manner.

In order to provide the needed flexibility, and hence improve the economy and efficiency of DOE's enrichment activities, I have introduced H.R. 2144 to establish in the U.S. Treasury an uranium enrichment revolving fund. Similar legislation has been introduced by Senator John Glenn of Ohio.

I would like now to discuss briefly this proposal that can help ensure the long-term availability of sufficient enriched uranium to meet domestic and foreign needs at the lowest possible cost without requiring additional taxpayers money. In fact, all of the capital and operating funds expended will be recovered through the sale of enrichment services.

The fund would consist primarily of proceeds from the sale of enriched uranium and of bonds sold to finance the construction of new enriched capacity. Congress will be able to make additional appropriations into the fund, but the fund could be completely self-supporting by the mid to late 80's. The Department of Energy will be authorized to use the fund to support all of its uranium enrichment acitivities, without further appropriation and without fiscal year limitation.

Thus, the Department of Energy will obtain the flexibility needed to manage the enrichment enterprise in all cost-effective manner. However, Congress will retain all necessary oversight over DOE's enrichment activities. DOE will not be allowed to begin construction on any new enrichment plants without express congressional authorization, nor will it be allowed to exceed by more than 15 percent in any fiscal year the plant and capital equipment outlays specified in the annual budget for those activities submitted by DOE and subject to change by Congress. In addition, the Department of Energy will be required to submit detailed annual reports to the Congress on all phases of operation of its enrichment enterprise and all financial activities in connection with the revolving fund.

Dozens of similar revolving funds have been set up in the U.S. Treasury to maintain a wide variety of self-supporting Federal programs. The enrichment revolving

fund has been patterned after, and would function in a manner closely resembling, the revolving fund that has successfully supported the activities of the Bonneville Power Administration since 1974.

At this point I would like to read to you some of the conclusions of the Uranium Enrichment Management Review team—a group of independent business executives that DOE asked to review the management of its uranium enrichment activities. In reference to the proposed uranium enrichment revolving fund, the Review Team stated:

"If a revolving fund were established, the enrichment enterprise would be managed as a self-sufficient entity, generating adequate cash flow for operation and capital outlay. The enterprise would have an exceptionally strong borrowing base, should bond financing become necessary for major capital expansion projects. This financial flexibility would enable it to time purchases vis-a-vis receipts, manage cash effectively, and employ other cost-saving techniques used by corporate management.

"Beside these financial advantages, the revolving fund would give the enterprise greater visibility among its domestic and overseas customers * * *."

Decisions on productivity levels and capacity expansion options are currently made on the basis of their impact on the annual budget rather than on long-term economics. For example, in fiscal year 1981 the construction of the gas centrifuge plant was delayed at least one year primarily for fiscal year 1981 Federal budgetary purposes. This 149 million dollar reduction resulted in an increased cost for plant construction of at least 200 million dollars. Similar cost increases would occur if there is another delay in construction.

Mr. Chairman, it is vitally important for this country to reestablish its position as a reliable supplier of uranium enrichment services at as low a price and as energy efficient as possible. For those reasons I urge you to approve the full Department of Energy request for construction of the Portsmouth Gas Centrifuge Enrichment Plant to keep the project on schedule. While recognizing that this is not a direct responsibility of this Committee, I also urge your support for the establishment of a uranium enrichment fund. The revolving fund will bring much needed stability to the enrichment enterprise. It will make the scheduling of projects like the Portsmouth plant less subject to annual budget constraints and will provide for increased flexibility and long range planning of uranium enrichment activities that will result in improved overall economy and efficiency.

Senator DOMENICI. Now, let me state for you and other witnesses that I can be here most of the morning and plan to, but I have to leave to testify before this committee, the Energy Committee, at around 10 o'clock. It should not take me over 10 minutes. If I do not have a Senator to relieve me, I will adjourn. If I do I will ask him to take over for me.

With that, you may proceed. We have your testimony. You use your own good judgment. It may be important enough for you to give your whole statement if we have time.

STATEMENT OF HON. SHELBY T. BREWER, ASSISTANT SECRETARY FOR NUCLEAR ENERGY, DEPARTMENT OF ENERGY, ACCOMPANIED BY WILLIAM R. VOIGT, JR., DEPUTY ASSISTANT SECRETARY FOR URANIUM ENRICHMENT AND ASSESSMENT

Dr. BREWER. Thank you, Mr. Chairman. I have with me this morning Deputy Assistant Secretary Bill Voigt, who runs our enrichment enterprise. And I do have a rather lengthy formal statement, Mr. Chairman, and I propose that I offer that for the record and summarize it orally.

Senator DOMENICI. All right. That will be made a part of the record.

Dr. BREWER. Before summarizing my formal statement, I would like to refresh your memory on the U.S. Uranium Enrichment Enterprise. DOE and predecessor agencies, ERDA and AEC have operated the Uranium Enrichment Enterprise for military and civilian nuclear power programs since the late 1940's or early 1950's.

Our customers are the U.S. Military Establishment and on the civilian side both U.S. and foreign utilities. Your hearing today, I believe, is concerned mostly with enrichment production for civilian power generation. May I have the first chart. The enrichment step in the fuel cycle, as you know, is on the front end. U-235 occurs in nature with an assay of about 0.7 percent. To make uranium useful in a nuclear power cycle, we must enrich the uranium to about 2 to 3 percent in U-235 for light water reactor use.

On the civilian side, next chart, our customers are both U.S. and foreign utilities. We hold contracts whose lifetime value is about $100 billion at this time, perhaps a little more. About two-thirds of that contract value is domestic utilities, a ıd the other third is foreign.

Senator DOMENICI. When you say contract value, would that be literal, are those contracts with that kind of longetivity built in or is that an estimate?

Dr. BREWER. Yes, sir. Those are over the lifetime of the contract or over the lifetime of the powerplant for which the contract was written.

Senator DOMENICI. Entered into.

Dr. BREWER. As you know, Mr. Chairman, we operate the enrichment enterprise in a full cost recovery mode. We recover all capital invested by the taxpayer, including a cost of the money component. We recover all operating, maintenance, energy, and all the other usual cost of doing business.

Our annual revenues are about $2 billion per year and this offsets a cost of about $2 billion per year. Now, next chart, looking broadly at the history and the future of the U.S. enrichment enterprise, there are three technological stages.

Senator DOMENICI. I want you to hold for a minute. I wanted to warn the Senator from Kentucky that he was 12 minutes late and in that 12 minutes we closed the facility at Paducah.

Senator FORD. You wait until we develop the hole to put the syringe in in New Mexico.

Senator DOMENICI. We have not started that yet. It is good to have you.

Senator FORD. It is always good to be with you, Mr. Chairman, because your good humor is always something I enjoy and if you can't reach that point of good humor, I have something to eliminate the malaise, called bourbon.

Senator DOMENICI. Do you produce that in Kentucky too?

Excuse me for interrupting. Go ahead.

Senator FORD. That is the enrichment process too, Mr. Chairman. See what happens when I come into a room. It is just awful. You lose your train of thought; people start laughing and you think the world is all right.

Dr. BREWER. I forgot where I was.

Senator FORD. For God's sake don't start over.

Senator DOMENICI. He had not said much. [Laughter.]

Dr. BREWER. Looking broadly, Mr. Chairman, at the history and the future of the U.S. enrichment enterprise, there are three major technological stages; first of all the gaseous diffusion complex, which we have now; beyond that the gas centrifuge technology, and then beyond that the advanced isotope separation technology.

We have three gaseous diffusion complexes. One at Paducah, Ky.; Oak Ridge, Tenn.; and Portsmouth, Ohio. The capacity of these three plants totals about 27 million separative work units per year. Beyond the gaseous diffusion complex, we are building the gas centrifuge enrichment project at Portsmouth, at Piketon. This will have a capacity of 13.2 million separative work units per year.

Beyond gas centrifuge, we are developing an advanced isotope separation process which we hope can come online in a commercial or a large scale fashion in the mid to late 1990's. Mr. Chairman, the central strategic question, which recurs at each step of our planning and has become a very popular issue over the past 5 or 6 years is whether we should skip gas centrifuge and go straight to an AIS process.

This would require, as you know, preproduction in the diffusion plants and stockpiling in order to meet the existing contracts, which GCEP at Portsmouth would cover. And that brings us, Mr. Chairman, to the substance of this hearing, the Department's review and comment on the May 25, 1982 General Accounting Office report, and the May 11, 1982 Congressional Research Service report on the gas centrifuge enrichment project, GCEP.

The Department of Energy was not provided with the opportunity to formally comment on the GAO report or the CRS report prior to their issuance and we are grateful, Mr. Chairman, for the opportunity to do so at this hearing. In general, the Department finds the GAO report misleading, lacking in balance, and in many areas shallow in its findings and supporting evidence.

The report reflects the naive and outdated view of the current international market environment, and is not objective in its analysis of GCEP versus the less proven advanced isotope separation processes. The report does not reflect an objective or comprehensive review of the Department's justification for GCEP, but selectively and narrowly focuses only on certain elements of DOE's enrichment analysis.

GAO exaggerates the importance of minor analytical variables at the expense of placing proper weight on those elements that form the real basis for DOE's enrichment strategy. DOE has also reviewed the recent Congressional Research Service report on uranium enrichment. The scope of the CRS report was limited to examining the need for GCEP to meet demand and recognizes that there may be other reasons for completing GCEP.

Because of its limited scope, the report does not represent a complete analysis on the need for GCEP. For example, the report does not contain any analysis of the relative economics or market effects of alternative production scenarios. The Department considers these elements to be of crucial importance to understanding the need for GCEP.

DOE continues to strongly support the need for GCEP based on the results of the Department's very thorough analyses of the alternatives available to the enrichment enterprise. These analyses carefully examine various production scenarios and evaluate the merits of each on the basis of cost, both to the Government and to the customer; impact on U.S. enrichment prices and our competitive position in the international market; on energy efficiency, and technical achievability. In all cases, Mr. Chairman, continued con-

struction of GCEP yields superior benefits both to the Government and its customers in terms of improving economics and production reliability.

In my view, the justification for GCEP can be summarized quite simply: without GCEP, the United States will price itself out of the enrichment business.

Senator FORD. Would you repeat that line?

Dr. BREWER. Without GCEP, Senator Ford, the United States will price itself out of the enrichment business.This is because the power cost component is escalating very rapidly. Gaseous diffusion plants are power guzzlers, if you will. They require lots of electrical energy, and if the electrical energy is escalating very rapidly the cost of separative work units also escalates very rapidly.

About 50 percent of the SWU price is attributable to power costs.

Senator DOMENICI. If we are going to be noncompetitive in the world market, I assume you have got competitors. Who are they and what system do they use?

Dr. BREWER. There are three major competitors, Senator, Eurodif, a French consortium, and their system is diffusion. Urenco, their system is gas centrifuge; and the Soviet Union with their diffusion system. The Eurodif complex competes with us rather handily, because they are powered by three nuclear power plants rather than coal-fired powerplants. And nuclear powerplants tend to insulate the power costs from inflationary pressures.

Once you get the capital investment made the fuel cycle cost is rather minor, unlike coal. For these reasons, Mr. Chairman, the rapid deployment of enrichment technology is capable of reducing U.S. production costs as a necessary and prudent business decision. Now, I realize there are pressures in the fiscal year 1983 Federal budget, but it must be kept in mind that all uranium enrichment budget requirements are fully offset by revenues. Enrichment pays its own way.

Also, any proposals to further delay the GCEP schedule as a means to reduce fiscal year 1983 spending would result in future cost increases far greater than the savings realized in the near term. Past delays in the project have only increased the costs of the facility and demonstrated the penny wise, pound foolish nature of such an approach.

I beg your indulgence to examine the disparity between the DOE view and the GAO report related to U.S. competitive position in world markets, enrichment demand both domestic and foreign, economic analysis, and the analytic tools and the assumptions used to plan the enrichment program, and the budget impacts of the GAO recommendation.

First, let us consider the U.S. competitive position in world SWU markets. Despite the GAO's claims, cancelling or delaying GCEP would seriously affect the competitive position of the United States in the international market. The United States has experienced a dramatic decline in foreign sales of enrichment services from about a 100 percent market share in the 1974 timeframe to about 35 percent share today.

A combination of factors in addition to price competition contributed to this phenomenon, including supply diversification needs, supply assurance, national goals, and other political and policy con-

siderations. However, our customers have consistently repeated since 1981 that future purchase decisions will be based primarily upon the availability of low enrichment prices, and the reasonable predictability of low prices in the future.

And our customers, furthermore, have universally accepted the concept that future enrichment prices will be more favorable with the incorporation of a more economical, less energy intensive centrifuge technology being installed in GCEP.

On May 10, 1982, just about a month ago, Egypt signed three new 30-year enrichment contracts with us, in addition to a modification of the one existing contract increasing the sales commitment by one-third. Sales from these four contracts are expected to total about $1.5 billion.

Since the first deliveries are not expected to be made until the early 1990's the role of GCEP to assure low cost enrichment services over the long term was a major factor in securing this significant sale. There are additional foreign sales opportunities in the next few years for over ten more contracts with an annual sales value in excess of $100 million, or lifetime sales of about $3 billion. These include new sales in Taiwan, Yugoslavia, in addition to follow-on contracts in the Federal Republic of Germany, Switzerland and the Netherlands. These customers have told us that price will represent a crucial element in these decisions. Future low cost enrichment from GCEP represents a necessary sales incentive in this regard.

It is my view, Mr. Chairman, that without GCEP we will not obtain another enrichment contract, ever. With regard to existing contracts, the Department currently holds domestic and foreign contracts with a lifetime sales value in excess of $100 billion, of which about one-third is foreign. While the termination provisions of these contracts vary, our customers can terminate the contracts at no cost with 3½ to 10 years' notice. These existing contracts are vulnerable to termination if the United States does not take action to keep our price competitive.

And it is also significant, Mr. Chairman, to note that U.S. utilities—the domestic market, has expressed a willingness to contract with Eurodif rather than the United States if the economies of U.S. enrichment services do not improve.

Let us turn next to enrichment demand, the central theme of the GAO and CRS reports. Based upon recent developments, we agree with GAO that the year 2000 demand projections contained in our last year's forecast have further eroded.

Our most recent preliminary assessment is that our new mid-range forecast by the year 2000 will be closer to the GAO projection of 217 gigawatts. However, the conclusion that we need GCEP to maintain the commercial viability of the U.S. enrichment enterprise is valid based upon any responsible demand forecast, including the GAO numbers.

The market to be served by the Department of Energy in the future will depend, to a very large extent, on actions we take today. The prediction of failure is a self-fulfilling prophecy. If we plan for failure or, rather, plan to fail—if we signal that we expect diminishing market shares, then that indeed will result.

We must take positive action, such as the construction of GCEP, to retain our existing contracts, and to capture new demand. Failure to construct the most cost efficient proven technologies available today will result in further reductions in U.S. sales as has been seen in other U.S. industries for their goods and services.

Let us turn now, very briefly, to GAO's economic analysis. GAO's economic analysis and justification for GCEP is incomplete and inaccurate. GAO focused very narrowly on the DOE economic model named EDIC used in the 1980 strategy study in evaluating DOE's economic justification for GCEP.

Other analyses have been performed, as reported in the December 1981 operating plan of the Department. Comparisons of the unit cost of product and future prices of enrichment services have also been prepared. I could fill this room with Department of Energy analyses of this subject. All of these analyses, Mr. Chairman support DOE's claim that completing GCEP will lower the costs of uranium enrichment and provide assurance that enrichment costs will not escalate rapidly if AIS is not available.

GAO assumes, first of all, low power cost escalation. They assume that AIS would come on line as projected and within costs, without any uncertainty, and, further, that GCEP costs would overrun. In other words, GAO carefully made assumptions which tended to support their thesis.

As you know, Mr. Chairman, a central feature of our strategy is the avoidance of diffusion plant power costs. GAO projected constant dollar electric power cost escalation of 0.4 percent per year through 1990 and zero percent thereafter. In other words, essentially no cost escalation in the power component.

This results in a 1990 rate that is only 3.2 percent higher than today's rate in constant dollars. Historically, over the past 10 years the cost of power to the uranium enrichment plants has increased an average of 10 percent per year over the general inflation rate. I cannot rationalize the GAO's assumption in regard to power costs escalation, or lack thereof.

Senator DOMENICI. What do you use?

Mr. VOIGT. In our analysis, Mr. Chairman, we have used two assumptions. One is the 1½-percent increase over the general inflation rate and the other is 3 percent. Historically the power escalation rate has been about 10 percent over the general inflation rate.

Senator DOMENICI. Thank you.

Dr. BREWER. The GAO analysis was not objective in its treatment of the relative uncertainties of GCEP and the AIS technologies. An analysis which assigns a cost penalty to the proven gas centrifuge technology and no penalty to the AIS technology which has not yet been demonstrated on a full scale basis is not an objective analysis.

There are, as you know, a number of major unresolved scientific and engineering issues that must be resolved before large scale deployment of the AIS process is possible. The earliest possible start of construction for its production facility for AIS would be in fiscal year 1990, about 1 year after operation of a developmental module.

This would allow full-scale operation if everything works right at the end of fiscal year 1995. This is, in fact, our planning target.

In GAO's economic analysis, they estimate a slight cost advantage in meeting demands with the diffusion plants plus AIS capac-

ity but without GCEP. This is the same result as previously indicated by DOE in the 1980 strategic study, if it were possible to assume complete success of the AIS program.

We are talking about, Mr. Chairman, a savings which is a small difference between two very large numbers. A difference, mind you, which is very sensitive to a number of very, very fragile assumptions. This slight savings disappears quickly if AIS fails to meet the 1995 target commercialization date. Just a 1 year slip in AIS availability with no increase in cost eliminates the $500 million AIS advantage, the advantage of leapfrogging GCEP.

If AIS slips 5 years then building GCEP has a $2.1 billion advantage. To the extent that AIS costs are higher than projected, or power costs escalate at a rate greater than GAO assumed the GCEP economic advantage increases. Even assuming the low GAO demand, similar results would occur.

In our view, Mr. Chairman, to make a case for cancelling GCEP on the basis of cost and schedule projections for a technology that will not demonstrate production readiness until the end of this decade, until 1990, would be unwise. While assuming perfection, schedule and cost perfection for AIS, GAO assumed for whatever reason GCEP will cost overrun. We have confidence in our GCEP construction cost estimate, Mr. Chairman.

To date, the estimated cost has remained stable with the exception of escalation and costs associated with the revised schedules due to budget pressures. There is good reason to believe that this excellent record will continue since the plant involves constructing eight process buildings which are essentially identical.

I will just speak now very briefly about the impacts of the GAO proposal on the Federal budget. GAO does not accurately provide the budgeting impacts of terminating GCEP. Should GCEP be terminated at the end of fiscal year 1982 the budget authority request for fiscal year 1983 for GCEP would be reduced from $613 million to $350 million.

The $350 million would be needed to pay termination costs for existing GCEP-related contracts. In addition, the uranium enrichment revenues would decrease by about $112 million in 1983 because GCEP costs would be deleted from the cost recovery charge. The net impact on the 1983 budget would be a decrease in the budget authority request of about $151 million.

Without GCEP additional production would have to come from the existing diffusion plants. The timing of production from diffusion capacity could be earlier than production from GCEP in order to minimize production costs. And, accordingly, our budget would be higher prior to 1988, thus, mitigating the impact of reduced GCEP costs. There would also be a decrease in the revenues for the next several years.

So much for the GAO report, Mr. Chairman. I would like now to comment very briefly on the recent CRS report on uranium enrichment. The focus of this report is quite narrow as contrasted to that of the GAO report, examining only the need for additional enrichment capacity to meet demand through 1995.

The CRS report indicates that DOE could avoid building additional enrichment capacity through fiscal year 1995 by operating the gaseous diffusion plants starting in fiscal year 1983 at full ca-

pacity. DOE acknowledges this. In our December 1981 operating plan analysis, we evaluated numerous scenarios in which no new U.S. enrichment capacity would be installed through 1995.

However, the economics of such a production mode are extremely unattractive unless AIS is completely successful in meeting its schedule and cost targets.

The CRS report also questions DOE's gigawatt growth projections. DOE's recent preliminary assessment of demand indicates a new midrange forecast for 1995 slightly higher than the CRS estimate. The difference appears to be primarily in the estimate for Japan.

The concern expressed by CRS that the Japanese growth supplied by DOE will be affected by the building of Japanese enrichment plant capacity is valid. DOE has taken the potential availability of this capacity into account in our demand projections. The CRS scenario would require the Japanese to terminate some of their existing contracts with us by 1995.

The Department believes that the Japanese will not terminate their existing contracts based on numerous assurances from the Japanese themselves. Further, given the current status of the Japanese enrichment technology, there is considerable uncertainty associated with the timing and economics of any Japanese enrichment venture.

The CRS report suggests that the DOE SWU demand may be overestimated by as much as 10 percent by not considering improved fuel designs and by assuming a 75-percent capacity factor. Such is not the case. In making our demand projections, we consider all pertinent factors including historical capacity factors, historical fuel utilization efficiencies, the availability of improved fuel designs and the customer estimates.

The CRS report contends that DOE could further reduce demand and the need for additional capacity by increasing the operating tails assay. This is partially correct. Operating at a higher tails assay for a sustained period is possible. However, this would require the purchase of larger quantities of uranium than would otherwise be required.

Sustained operation at high tails assay carries a large economic penalty to both DOE and the customer and, therefore, has been rejected.

In summary, Mr. Chairman, the Department has major problems with the GAO report and in our view the CRS report should not be viewed as something it was not intended to be, that is a comprehensive analysis for the need for GCEP.

This completes, Mr. Chairman, my formal statement. I would be pleased, with Mr. Voigt, to answer any questions you may have at this time. Thank you.

[The prepared statement of Dr. Brewer follows:]

Statement of Shelby T. Brewer
Assistant Secretary for Nuclear Energy
Department of Energy
Subcommittee on Energy Research and Development
Committee on Energy and Natural Resources
U.S. Senate
June 24, 1982

Mr. Chairman and Members of the Committee, I am pleased to appear before you to discuss the May 25, 1982, General Accounting Office (GAO) and the May 11, 1982, Congressional Research Service (CRS) reports on the Gas Centrifuge Enrichment Plant (GCEP).

The Department of Energy (DOE) was not provided with the opportunity to formally comment on the GAO or the CRS reports prior to their issuance. GAO subsequently asked the Department for its comments.

In general, DOE finds the GAO report misleading, lacking in balance, and in many areas, shallow in its findings and supporting evidence. The report reflects a naive and outdated view of the current international market environment and is not objective in its analysis of GCEP versus the less proven Advanced Isotope Separation (AIS) processes. The report does not reflect an objective or comprehensive review of DOE's justification for GCEP, but selectively and narrowly focuses only on certain elements of DOE's enrichment analysis. GAO exaggerates the importance of minor analytical variables at the expense of placing proper weight on those elements that form the real basis for DOE's enrichment strategy.

DOE has also reviewed the recent Congressional Research Service (CRS) report on uranium enrichment. The scope of the CRS report was limited to examining the need for GCEP to meet demand and recognizes that there may be other reasons for completing GCEP. Because of the limited scope, the report does not represent a complete analysis of the need for GCEP. For example, the report does not contain any analysis of the relative economics or market effects of alternative production scenarios. The Department considers these elements to be of crucial importance to understanding the need for GCEP.

DOE continues to strongly support the need for GCEP based on the results of the Department's thorough analyses of the alternatives available to the enrichment enterprise. These analyses carefully examine various production scenarios and evaluate the merits of each on the basis of cost, both to the Government and to the customer; impact on U.S. enrichment prices and our competitive position in the international market; energy efficiency; and technical achievability. In all cases, continued construction of GCEP yields superior benefits both to the Government and its customers in terms of improved economics and production reliability.

In my view, the justification for GCEP can be summarized quite simply: without GCEP, the United States will price itself out of the enrichment business. Even at reduced demand levels, the cost of production from GCEP in current year dollars will be significantly lower than production from the existing electricity intensive gaseous diffusion plants (GDPs). When escalation is

factored in, the difference between GCEP and GDPs becomes very large. The rapid deployment of enrichment technologies capable of reducing U.S. production costs is a necessary and prudent business decision. Our centrifuge technology is the most advanced proven enrichment technology in the world and offers the U.S. the opportunity to halt the erosion in our existing enrichment contract base and to regain its leadership and market share in the international nuclear community. The Advanced Isotope Separation (AIS) technology currently under development by the Department offers the promise of even lower future costs but must reach a much higher stage of development before it can be counted on for production planning.

I realize there are pressures on the FY 1983 Federal budget, but it must be kept in mind that all uranium enrichment budget requirements are fully offset by revenues. Also, any proposals to further delay the GCEP schedule as a means to reduce FY 1983 spending would result in future cost increases far greater than the savings realized in the near term. Past delays in the project have only increased the costs of the facility and demonstrated the "penny wise, pound foolish" nature of such an approach.

U.S. Competitive Position

Despite GAO's claims, cancelling or delaying GCEP would seriously affect the competitive position of the U.S. in the international

market. The U.S. has experienced a dramatic decline in foreign sales of enrichment services, from a 100 percent market share in 1974 to about 35 percent in 1980.

Today, the U.S. share of the foreign market remains at about 35 percent. A combination of factors in addition to price contributed to this phenomenon, including supply diversification needs, supply assurance, national goals and politics. However, our customers have consistently repeated since 1981 that these other factors are now relatively insignificant and future purchase decisions will be based primarily upon the availability of low enrichment prices and the reasonable predictability of low prices in the future.

We have emphasized to all existing and potential customers that appreciable cost reductions are expected in the U.S. enrichment program by virtue of U.S. leadership in and utilization of advanced enrichment technologies. Our customers universally accept the concept that future enrichment prices will be more favorable with the incorporation of the more economical, less energy intensive centrifuge technology being installed in GCEP.

On May 10, 1982, Egypt signed three new 30-year enrichment contracts with the U.S. in addition to a modification of the one existing contract increasing the sales commitment by one-third. Sales from

these four contracts are expected to total about $1.5 billion. Since the first deliveries are not expected to be made until the early-1990's, the role of GCEP to assure low cost enrichment services over the long term was a major factor in securing this sale. There are additional foreign sales opportunities in the next few years for over 10 contracts with an annual sales value in excess of $100 million (lifetime sales would represent about $3.0 billion). These include new sales in Taiwan and Yugoslavia in addition to follow-on contracts in the Federal Republic of Germany, Switzerland, and the Netherlands. These customers have told us that price will represent a crucial element in these decisions. Future low cost enrichment from GCEP represents a valuable sales incentive in this regard.

The Department currently holds domestic and foreign contracts with a lifetime sales value in excess of $100 billion, of which about one-third is foreign. While the termination provisions of these contracts vary, our customers can terminate the contracts at no cost with 3-1/2 to 10 years notice. These existing contracts are vulnerable to termination if the U.S. does not take action to keep our price competitive.

Without GCEP, U.S. enrichment prices will be perceived by our customers and has already been emphasized by our competitors, Eurodif and Urenco, as being significantly higher in the future. Eurodif, due in part to the weakness of the French franc, presently offers enrichment prices slightly lower than the U.S. price. They stand to realize a considerable market advantage if the potential of

GCEP is not realized in the U.S. It is also significant to note that U.S. utilities have expressed a willingness to contract with Eurodif rather than the U.S. if the future economies of U.S. enrichment services do not improve. Though a detailed estimate of potential sales losses is not possible, the continued strength and vitality of a U.S. Government enterprise which produces $2 to $3 billion in annual revenues, of which about one-third represents a positive contribution to the U.S. balance of payments position, is a worthwhile consideration. In this regard, the commitment to building GCEP is a major positive force. We strongly disagree with GAO that this balance of payment impact, almost $1 billion in FY 1983, is insignificant and can, therefore, be ignored. When our nation is in a negative trade balance, all large contributions are important in reducing the deficit.

Enrichment Demand

Based upon recent developments, we agree with GAO that the year 2000 demand projections contained in our last year's forecast have further eroded. Our most recent preliminary assessment is that our new mid-range forecast by the year 2000 will be closer to the GAO forecast of 217 gigawatts. However, the conclusion that we need GCEP to maintain the commercial viability of U.S. enrichment is valid based upon any responsible demand forecast, including the GAO numbers.

The market to be served by DOE in the future will depend, to a very large extent, on actions we take today. We must take positive actions,

such as construction of GCEP, to retain our existing contracts and to capture new demand. Failure to construct the most cost efficient proven technologies available today will result in further reductions in U.S. sales as has been the case in other U.S. industries for their goods and services.

GAO's Economic Analysis

GAO's analysis of DOE's economic justification of GCEP is incomplete and inaccurate. GAO focused on the DOE economic model (EDIC) used in the 1980 Strategy Study in evaluating DOE's economic justification for GCEP. Other analyses have been performed, as reported in the December 1981 Operating Plan Paper. Comparisons of the unit cost of product and future prices of enrichment services have also been prepared. All of these analyses support DOE's claim that completing GCEP will lower the costs of uranium enrichment and provide assurance that enrichment costs will not escalate rapidly if AIS is not available.

GAO questions the economic benefits of GCEP by assuming that demand is by far the most critical factor affecting GCEP economics. This is not true. While demand levels are an important factor, more important considerations are the introduction date and cost of AIS, power cost escalation, general inflation, and GCEP costs. GAO also assumed low power cost escalation, that AIS will come online as projected and within costs, and that GCEP costs will overrun.

In structuring its economic analysis, GAO projected constant dollar electric power cost escalation of 0.4 percent per year through 1990 and 0 percent thereafter. This results in a 1990 rate that is only 3.2 percent higher than today's rate in constant dollars. GAO indicated that these results were consistent with the mid-case electric power price escalation rate in the Energy Information Administration (EIA) 1981 Annual Report to Congress. Tabular data from that report show that EIA is projecting industrial power cost growth in the period 1980 to 1995 ranging from 1.2 to 1.7 percent per year above general inflation. This results in a real increase that is three to four times the GAO figure. Over the last 10 years the cost of power to the uranium enrichment plants has increased an average of about 10 percent per year over the general inflation rate.

Furthermore, GAO has not considered the impact of renewing DOE's power contracts, which are expiring in the early 1990's. Less favorable terms and conditions are likely to result in new power contracts, which could increase the long-term costs of power significantly.

The GAO analysis was not objective in its treatment of the relative uncertainties of GCEP and the AIS technologies. An analysis which assigns a cost penalty to the proven gas centrifuge technology and no penalty to the AIS technology which has not yet been demonstrated on a full scale is not an objective analysis. DOE has recently announced the selection of one of the three competing AIS technologies for large-scale engineering and demonstration. However, there are still substantial scientific and engineering

issues that must be resolved before large-scale deployment of the selected process is possible. The unresolved issues raise uncertainties as to the ultimate date of production deployment and the cost of production.

The definitive resolution of these uncertainties will require the design, construction, and operation of a Development Module. It is important to realize that the commercial viability of the AIS process cannot be established until 1990 at the earliest, one year after operation of a Development Module. Therefore, the earliest possible start of construction for a production facility would be in FY 1990 and full scale operation at the end of FY 1995.

In GAO's economic analysis, they estimate a cost advantage in meeting demands with the GDPs plus AIS capacity but without GCEP. This is the same result as previously indicated by DOE in the 1980 Strategy Study if it were possible to assume complete success of the AIS program. This slight savings disappears quickly if AIS fails to meet the 1995 target commercialization date. The major concern in the DOE enrichment program is that GDP production costs are increasing due to its dependence on electric power. Savings can be realized by replacing it with lower cost capacity, either gas centrifuge, AIS, or a combination of both. Using all of GAO's recommended assumptions, the net present value savings of replacing GDP capacity with GCEP and AIS is $8.5 billion. If AIS alone is used and available beginning in 1995 to replace GDP capacity, the savings would be $9.0 billion

which is $0.5 billion better than building GCEP and AIS together. However, just a 1-year slip in AIS availability with no increase in cost eliminates this $0.5 billion AIS advantage. If AIS slips 5 years, then building GCEP has a $2.1 billion advantage. To the extent that AIS costs are higher than projected, or power costs escalate at a rate greater than GAO assumed the GCEP economic advantage increases. Even assuming the low GAO demand, similar results would occur.

DOE must maintain an assurance of adequate production capacity to meet contractual demand. Under our present operating plan, which includes GCEP, we are able to significantly reduce power purchases needed to operate the GDP in the mid-1990's and later. If a decision is made to terminate GCEP and rely on AIS, we would have to sign contracts for additional amounts of power in the near future as a contingency against possible delays or failure to develop the AIS. If AIS is successful, then DOE would have to terminate some of the power contracts and pay capacity charges. If AIS is unsuccessful, then the GDP would be our only capacity, and, clearly, we would be at a major price disadvantage with our competitors. Either situation is uneconomical.

In our view, to make a case for cancelling GCEP on the basis of cost and schedule projections for a technology that will not demonstrate production readiness until the end of this decade would be unwise.

Computer Model

We feel that much of GAO's criticism of the computerized model is unfounded. GAO is justified in criticizing the lack of documentation. However, DOE did not "constrain the model." The term "constrain" is simply inappropriate for discussing the two-step procedure which was used to run some of the cases in the October 1980 Uranium Enrichment Strategy Study. GAO's contention that the model does not in one instance reflect economic reality is not valid. Finally, the model's use of an approximation of the year that the feed stockpile is depleted has been shown not to result in any significant bias between alternative cases.

GCEP Costs

We have confidence in our GCEP construction cost estimate. To date, the estimated cost has remained stable with the exception of escalation and costs associated with the revised schedules. There is good reason to believe that this excellent record will continue since the plant involves constructing eight process buildings which are essentially identical. The bulk of the technical support and engineering has been completed providing a sound basis for estimating procurement and construction costs. We have bid experience on 90 percent of the construction and procurement packages, other than the centrifuge machines. The centrifuge machine cost is 40 percent of the plant cost. The only estimating difficulty in centrifuge cost is the rotor. The cost associated with the rotor represents less than one-fourth of the total machine cost, or less than 10 percent of the total project cost.

Budgetary Impacts

GAO does not accurately provide the budgeting impacts of terminating GCEP. Should GCEP be terminated at the end of FY 1982 the budget authority request for FY 1983 for GCEP could be reduced from $613 to $350 million. The $350 million would be needed to pay termination costs for existing GCEP-related contracts. In addition, uranium enrichment revenues would decrease by about $112 million in 1983 because GCEP costs would be deleted from the cost recovery charge. The net impact on the 1983 budget would be a decrease in the budget authority request of $151 million.

Budget outlays for FY 1983 would actually increase from $525 million to about $700 million. This happens from spending the additional $350 million in budget authority that would be needed plus spending the end of FY 1982 commitments.

Without GCEP, additional production would have to come from the existing gaseous diffusion plants. The timing of production from diffusion capacity could be earlier than production from GCEP in order to minimize production costs. Accordingly, power budgets could be higher prior to 1988; thus, mitigating the impact of reduced GCEP costs. There would also be decreased revenues in the next several years.

Congressional Research Service Report

I would now like to comment on the recent CRS report on uranium enrichment. The focus of this report is quite narrow as contrasted to that of the GAO report, examining only the need for additional enrichment capacity to meet demand through 1995.

The CRS report indicates that DOE could avoid building additional enrichment capacity through FY 1995 by operating the gaseous diffusion plants starting in FY 1983 at full capacity. DOE acknowledges this. In our December 1981 operating plan analysis, we evaluated numerous scenarios in which no new U.S. enrichment capacity would be installed through 1995. However, the economics of such a production mode are extremely unattractive unless AIS is completely successful in meeting its schedule and cost targets.

The CRS report also questions DOE's gigawatt growth projections. DOE's recent preliminary assessment of demand indicates a new mid-range forecast for 1995 slightly higher than the CRS estimate. The difference appears to be primarily in the estimate for Japan. The concern expressed by CRS that the Japanese growth supplied by DOE will be affected by the building of Japanese enrichment plant capacity is valid. DOE has taken the potential availability of this capacity into account in our demand projections. The CRS scenario would require the Japanese to terminate some of their existing contracts with us by 1995. DOE believes that the Japanese will not terminate their existing contracts based on numerous assurances from the Japanese

themselves. Further, given the current status of the Japanese enrichment technology, there is considerable uncertainty associated with the timing and economics of any Japanese enrichment capacity.

The CRS report suggests that the DOE SWU demand may be overestimated by as much as ten percent by not considering improved fuel designs and by assuming a 75 percent capacity factor. Such is not the case. In making our demand projections, we consider all pertinent factors including historical capacity factors, historical fuel utilization efficiencies, the availability of improved fuel designs, and customer estimates.

The CRS report contends that DOE could further reduce demand and the need for additional capacity by increasing the operating tails assay. This is partially correct. Operating at a higher tails assay for a sustained period is possible, however, this would require the purchase of larger quantities of uranium than would otherwise be required. Sustained operation at high tails assay carries a large economic penalty to both DOE and the customer and, therefore, has been rejected.

In summary, Mr. Chairman, DOE has major problems with the GAO report and, in our view, the CRS report should not be viewed as something it was not intended to be, that is, a comprehensive analysis of the need for GCEP.

11-564 O—82——3

Senator DOMENICI. Thank you very much, Dr. Brewer. I am pleased that the chairman of the committee has arrived, Senator McClure. I would ask if he has any remarks or questions at this point. I yield to you, Senator.

The CHAIRMAN. I thank you, Senator. I have an opening statement that I would like to be made a part of the record of this hearing this morning.

Senator DOMENICI. It will be made part of the record.

[The prepared statement of Senator McClure follows:]

STATEMENT OF HON. JAMES A. MCCLURE, A U.S. SENATOR FROM THE STATE OF IDAHO

As we begin I would like to make some brief remarks that reflect general views that I hold on the subject of uranium enrichment. I have long been a proponent of nuclear energy development, both domestic and abroad. Over the years I have become increasingly concerned about the extent to which our nuclear technology has become politicized and the degree to which some of our nonproliferation efforts have reduced both our leadership role and the attractiveness of our products in the world marketplace. Several weeks ago at a hearing that I chaired in the Senate Appropriations Subcommittee on Energy and Water Development I had the opportunity to discuss this issue with Assistant Secretary Brewer at some length.

As part of additional information provided to us for the record, the Assistant Secretary stated:

"The attractiveness of our products has been reduced by our inability to provide reliable fuel cycle services to the potential nuclear reactor buyer. To buy a reactor from an American vendor leaves the customer with the added problem of conforming to elaborate restrictions that are not imposed by other suppliers such as arranging for reprocessing of the spent fuel. The extent of this impact is demonstrated in the reduced orders for reactors from U.S. vendors, severe competition in the market, and increases in foreign orders for enrichment services from foreign suppliers."

I would hope as part of the debate that will occur on the uranium enrichment program that we not loose sight of the primary factors that have diminished the U.S. role in the world marketplace. I believe this can be traced to the nonproliferation policies of previous administrations and actions taken by the Congress which have resulted in the United States attaching political restraints to what would otherwise be legitimate articles of commerce.

I understand that President Reagan has approved a new reprocessing and plutonium use policy for the U.S. which sanctions long-term, programmatic arrangements for reprocessing and plutonium use in Japan, Euratom and perhaps other Western European countries outside Euratom. While I have not reviewed this policy in detail—I fully support it in principle since I believe that such modifications to existing policy are necessary to restore our credibility in the world marketplace.

Senator DOMENICI. Let me ask a few questions and then I will yield to Senator Ford and Senator McClure. Could you provide the committee with more details, perhaps a table, which would detail the costs on an annual basis that you referred to that would be attributable to a delay in GCEP's schedule?

You have indicated that may reduce some spending in 1983, but would result in future cost increases that you say are far greater than the savings realized in near term. Could you give us a schedule showing what DOE says they are annually.

Dr. BREWER. We would be happy to. Several things happen. You eliminate the $613 million, but you have to add back to provide for termination costs. In addition, you have to up the cascade power requirement, which increases the total budget requirement for fiscal year 1983. There are several things operating here and we would be happy to provide those scenarios to you.

[The information follows:]

BUDGET IMPACT OF A DELAY OR TERMINATION OF GCEP

The following table shows the impact on the fiscal year 1983 budget authority request if GCEP is terminated at the end of fiscal year 1982.

[In millions of dollars]

Uranium enrichment	fiscal year 1983 budget to Congress	If amended for GCEP termination	Change
GCEP	613	350	−263
All other	1,354	1,354	0
Total	1,967	1,704	−263
Revenues	−2,033	−1,921	+112
Net	−66	−217	−151

In fiscal year 1983 $350 million would be needed to pay termination costs for existing GCEP-related contracts, primarily with the centrifuge manufacturers and material suppliers. Revenues would decrease in fiscal year 1983 because GCEP costs, primarily imputed interest on construction work in process, would have to be deleted from the cost recovery charge.

In fiscal year 1984 and beyond the budget impact would depend on the revisions to the operating plan which would be necessary without GCEP. In general, the following impact would occur:

(1) No funds would be needed for GCEP. This would save about $5.4 billion in fiscal year 1983 dollars from fiscal year 1984 through fiscal year 1994.

(2) The lost GCEP production would have to be made up by increasing gaseous diffusion plant production. The specific timing of the increase in diffusion production would depend on the availability of power, economics, and annual demand projections. From fiscal year 1984 to fiscal year 2000 about $20 billion in additional power costs will be incurred as a result of not building GCEP.

(3) Revenues would be reduced until the late 1980's when the loss of economic GCEP production will result in significant increases in the cost recovery charge.

Should GCEP be delayed similar results occur. Any savings realized in fiscal year 1983 by delaying GCEP results in the necessity to request equivalent funding later at greater cost because of inflation. Also, the total cost to complete the project will increase in constant dollars by about $300 million because of the need to keep construction managers and related supporting activities for a longer period of time. Further, a delay increases interest costs as the total investment increases in amount and in duration. The delay in GCEP production will require a corresponding increase in diffusion production and higher budget requests for power.

Senator DOMENICI. You indicated that GAO correctly pointed out that the eventual costs for construction for GCEP would be borne by the uranium enrichment customer. They do, however, in their report point out that there are near term budget effects for the construction of GCEP.

Do you in assessing the cost include all of the associated financial costs?

Dr. BREWER. Mr. Chairman, the separative work units pricing formula is based on recovery costs. It recovers all cost components for enrichment, including depreciation, imputed interest on the governments investment, all operating costs maintenance, salaries and power costs.

The fact is that when you buy a SWU you are burdened with all of those cost components. The user pays all of the costs. There is no hidden subsidy provided by the taxpayer.

Senator DOMENICI. I just wondered if you actually include the debt service that might be attributable because we have a $100 billion deficit that we are financing at 14 and 15 percent.

Mr. VOIGT. Mr. Chairman, we do include the equivalent of debt services. For example, within the SWU charge which will go into effect on August 21 of this year, I believe about $25 per SWU is included to cover the debt service, or interest during construction for GCEP.

Senator DOMENICI. Could you furnish us with evidence as to what that $25 allegedly covers? Maybe that is the way we could get to that and maybe we can conclude from it. That will work.

[The information follows:]

RECOVERY OF GCEP COSTS

Section 161v of the Atomic Energy Act requires that the charge for enrichment services recover the Government's costs over a reasonable period of time. The Uranium Enrichment Services Criteria identify the cost components which must be included in the charge. Imputed interest on the government's investment in uranium enrichment is included as a cost component.

On February 19, 1982, DOE announced new prices to become effective on August 21, 1982, of $138.65 per SWU for Adjustable Fixed-Commitment contracts and $149.85 or the ceiling charge for Requirements-type contract, whichever is lesser. In arriving at these prices, DOE estimates costs and sales for a ten year period and arrive at a levelized price. For the ten year period total interest costs amount to $9,559 million out of total costs of $33,452 million or $39.62 per SWU of the $138.65 per SWU price.

Costs that specifically related to GCEP amount to $19.30 per SWU of the $138.65 per SWU price. Almost all of this represents imputed interest on the government's investment in GCEP, that is construction work in process. Also included is a small amount of GCEP depreciation and operating costs.

Senator DOMENICI. Your testimony also, Dr. Brewer, refers to your customers' acceptance, as I understand it, of the concept that future enrichment prices will be more favorable with the installation of GCEP and I understand that. It is basically newer technology, but for the most part it is less energy cost once you get the new one built, five percent of the present energy utilization per unit of production.

Dr. BREWER. Yes, sir, a factor of 20 reduction in energy usage.

Senator DOMENICI. Could you provide the Committee with any letters or communications that would verify that position, that some customers present and those that you are negotiating with stay onboard because they expect the next event to occur?

Dr. BREWER. Yes, sir. We will provide a summary of our verbal conversations.

Senator DOMENICI. Have your customers inquired into the likelihood of GCEP being either stopped or slowed down?

Dr. BREWER. Yes, sir.

Senator DOMENICI. Do you have evidence to give us that they have?

Dr. BREWER. Yes, sir. We would be happy to provide a summary of our oral conversations or records thereof for the record.

[The information follows:]

CUSTOMER REACTION TO GCEP

DOE has engaged in numerous discussions with enrichment customers over the last few years regarding the potential of low cost enrichment services from the Gas Centrifuge Enrichment Plant (GCEP). DOE has placed particular emphasis on contacting customers representing either potential new sales or follow-on sales opportu-

nities to expiring DOE contracts. A positive reaction to lower enrichment costs from GCEP has been received from many of DOE's customers. In particular, all the utilities in Japan, South Korea, Taiwan, Federal Republic of Germany, Switzerland, Netherlands, Spain and Sweden have noted that future enrichment prices will be a major factor in their purchase decisions. These customers have acknowledged that lower enrichment costs from GCEP represent a significant market advantage for DOE. The total sales potential is about $4 billion from new and follow-on contracts in these countries. Maintaining a firm commitment to GCEP will strengthen DOE's ability to capture these sales as well as to prevent existing customers from terminating existing DOE contracts as a result of higher prices from an enrichment complex using only gaseous diffusion. This assessment of customers' perceptions of GCEP's market advantage is a direct result of many conversations with the aforementioned utilities. To protect the confidentiality of these supplier-customer interactions, we would propose to discuss the details of these conversations privately with the committee staff.

Senator DOMENICI. So basically if that is the case it appears that if the congressional action causes concern or the potential congressional action that we are almost in a self-fulfilling prophecy situation, because if they become worried about that then indeed the prophecy that the need will go down will come into being.

Dr. BREWER. Yes, sir.

Senator DOMENICI. You were telling us that with reference to the foreign markets.

Dr. BREWER. I am telling you that with respect to both markets, Mr. Chairman. If they see that we are not going after a technology that will reduce the total fuel cycle cost the validity of nuclear power will be generally reduced and we would expect fewer orders.

Senator DOMENICI. In your statement, let me move to some of the numbers. You note in several places that even using GAO numbers construction of GCEP is valid. At one point you state that using all of their recommended assumptions the net present value savings of replacing the GDP capacity with GCEP and AIS is $8.5 billion. Is that right?

Dr. BREWER. Yes, sir. And that results from, principally from offloading or displacing the high power cost for the diffusion plant in the late 1990 time frame.

Senator DOMENICI. Well, if that $8.5 billion is so, at another place in the GAO report, it states that using its assumption, the DOE's computerized model shows it would still be more expensive to provide enrichment services over the long range if the centrifuge plant were built than if it were not.

Could you explain this apparent discrepancy. You said the GAO analysis is inaccurate. Are you saying the cost savings they claim are inaccurate or is there some other difference that I do not understand that is more subtle?

Mr. VOIGT. Mr. Chairman, the basis for the GAO statement was predicated on the assumption that the advanced isotope separation technique would be available in 1995.

However, as we indicated in our analysis that even with the low forecast, and using our assumptions in terms of escalation of power costs, then in our cases it was favorable to build GCEP and even to accelerate the schedule.

Senator DOMENICI. Let me jump ahead for 1 minute and talk about something that is of concern to me. As I understand it now, as far as private, commercial involvement, this top end and the tail end, they are the only ones that are not privatized. The middle is

privatized. This is not and major proposals for disposal keep that governmental.

Dr. BREWER. Yes, sir.

Senator DOMENICI. We have already started GCEP and made, at least, an upfront decision that it was going to be a governmental not privatized. Is any thought being given to at least moving toward privatization for the advanced isotope separation technology?

Mr. BREWER. Yes, sir. Mr. Chairman, we are giving a great deal of thought toward a transition to privatization of the centrifuge complex as well. We are having informal discussions with industry. That is very attractive to privatization because of the lower costs, it is not as capital intensive as centrifuge and diffusion plant capacity by a substantial margin.

So AIS lends itself to a private sector investment and we are examining that option.

Senator DOMENICI. Dr. Brewer, can you provide the subcommittee with any information you may have on this possible option?

Dr. BREWER. Yes, sir.

Senator DOMENICI. How long will it take for you to get that together?

Dr. BREWER. We can within a number of weeks bring you up to date on the discussions we have had to date.

Senator DOMENICI. In your statement you contend that the enrichment demand——

Senator FORD. Mr. Chairman, I don't want to interrupt you, but could that report, you said in several weeks, could that be made a part of this hearing?

Senator DOMENICI. I would think so. It would not be a very lengthy one.

Dr. BREWER. No, it would be a brief report.

Senator FORD. I just want it part of the record.

[The information follows:]

PRIVATIZATION OF URANIUM ENRICHMENT

Recently the Under Secretary, Mr. Guy Fiske, discussed the subject of privatization of the uranium enrichment activities with executives of the Goodyear Aerospace Corporation of Akron, Ohio. The attached report entitled "Considerations Regarding Privatization of United States Uranium Enrichment Services (UES)," prepared by Goodyear was discussed at the meeting.

CONSIDERATIONS REGARDING PRIVATIZATION OF UNITED STATES URANIUM ENRICHMENT SERVICES (UES)

MAY 1982

35

GOODYEAR AEROSPACE CORPORATION
Akron, Ohio

HISTORICAL OVERVIEW

Serious consideration for establishing a private enrichment industry was first reviewed by the government in 1968 when discussions with the nuclear industry were initiated. Congressional hearings on the privatization of uranium enrichment were initiated in 1972 and continued through 1976. During this period, Congress solicited the views of not only private industry as the potential operator of an enrichment plant but also of utility customers, both foreign and domestic, the financial community, and key government agencies already involved in nuclear power. As a result of these hearings, legislation was introduced in 1975 for serious Congressional consideration.

Concurrently with the above-mentioned Congressional considerations, the Atomic Energy Commission (AEC) and subsequently, ERDA, processed a sufficient number of enrichment orders with domestic and foreign utilities so that in 1974 the U.S. order book for enrichment services was closed. This action was necessitated by law which would not permit accepting commitments beyond the capacity of the existent enrichment plants.

In parallel with the above actions, ERDA began negotiations with industry for contracts covering the transfer of production technology from the government to private industry in anticipation of the potential establishment of a private enrichment industry in the U.S. Four contracts were successfully negotiated. These contracts included consortiums involving Exxon; Atlantic-Richfield and ENI (Centar Associates); The Signal Companies (Cengex); Bechtel and Goodyear; and The Williams Companies (UEA).

In 1976, Congress rejected the concept of private enrichment. As a result, action was taken by ERDA to implement the expansion of government gaseous diffusion enrichment plants. This expansion program was later modified to utilize the more modern technology of centrifuge enrichment.

HISTORICAL OVERVIEW

PRIVATE URANIUM ENRICHMENT SERVICES

1968	FIRST SERIOUS CONSIDERATION OF PRIVATE ENRICHMENT IN U.S. BY AEC, CONGRESS, AND INDUSTRY.
1972	CONGRESSIONAL HEARINGS ON PRIVATIZATION OF ENRICHMENT INITIATED.
1973-74-75-76	CONGRESSIONAL HEARINGS ON PRIVATE ENRICHMENT CONTINUED.
1975	ERDA NEGOTIATES CONTRACTS WITH INDUSTRY FOR TRANSFER OF ENRICHMENT PRODUCTION TECHNOLOGY AND NEEDED GOVERNMENT SUPPORT; FOUR CONSORTIUMS RESPOND.
1976	CONGRESS REJECTS PRIVATE ENRICHMENT ENABLING LEGISLATION.

HISTORY OF GOODYEAR URANIUM ENRICHMENT PARTICIPATION

In 1971, at the invitation of the Atomic Energy Commission (AEC), Goodyear expressed its serious interest in participating in the establishment of a private uranium enrichment industry in the U.S. This interest was effectively communicated to AEC in proposal form in late 1972. In January 1973, a contract was signed between the Atomic Energy Commission and Goodyear granting access to classified enrichment technology.

In return for this access, Goodyear accepted an obligation to actively participate in the development of new enrichment technologies and expressed its willingness to provide production facilities for the fabrication of enrichment equipment. Based on the demand forecast for enrichment services, it was expected that a commercial enrichment industry would evolve and many new enrichment plants would be built. As a result, Goodyear invested more than $25 million in developmental facilities and in the development of advanced gas centrifuge equipment.

In preparation for the potential commercial enrichment market, Goodyear also joined with the Bechtel Corporation and The Williams Companies in forming Uranium Enrichment Associates (UEA), a consortium dedicated to becoming a commercial enrichment plant owner and operator. With the rejection by Congress of private enrichment in 1976, this latter venture was disbanded. In addition, the potential for a multi-customer market for enrichment equipment disappeared and the potential marketplace became a single customer; namely, the Department of Energy's Gas Centrifuge Enrichment Plant (GCEP) expansion project at Portsmouth, Ohio.

At the invitation of the Department of Energy, Goodyear submitted a proposal in 1979 covering the initial production of centrifuges for the GCEP plant. Goodyear's proposal was accepted. As a result, more than $28 million of corporate funds has been invested in the establishment of new production facilities for centrifuge manufacture. These facilities are now in operation, and deliveries of centrifuge equipment are being provided to the Department of Energy.

Increased production of centrifuges for the GCEP program is expected under a Phase II contract to be negotiated with DOE or its successor organization in 1984. This expansion will require additional corporate capital investment by Goodyear in order to provide additional manufacturing capacity for the higher rate production.

GOODYEAR PRIVATE URANIUM ENRICHMENT PARTICIPATION

1971	Submitted qualifying proposal to AEC (22 companies participated)
1972	Submitted proposal to AEC outlining proposed industrial participation program
1974	Goodyear becomes a member of Uranium Enrichment Associates (UEA)
1976	UEA is disbanded when Congress rejects Nuclear Fuel Assurance Act
1979	Contract received from DOE for initial GCEP centrifuge production ($28M committed for new capital for production facilities in addition to $25M previously invested in centrifuge development)

SPECIAL REQUIREMENTS FOR COMMERCIAL ENRICHMENT CONTRACTS IN 1975

During the negotiations between private industry and ERDA in 1975 concerning the transfer of government enrichment technology to industry, a series of meetings was held to evolve acceptable contract terms. These meetings included not only industry but also utility customers and members of the financial lending community.

As a result of these meetings, preliminary contracts were negotiated between industry and the government and between the potential enrichment companies and the utility customers. These contracts, while never consummated, included those terms and conditions deemed necessary to protect all parties concerned. The government's interest with regards to the protection of classified information and the payment of royalties for the use of government technologies were established. Utilities' concerns were addressed in terms of providing backup supplies of enriched uranium as well as protection in the event of untimely termination of any specific enrichment venture. The potential enricher's protection, in terms of technology warranties and special government guarantees and safeguards, was defined.

The following page summarizes some of the key special requirements defined during these negotiations. It should be expected that similar provisions would be required in the process of considering private enrichment at this time.

SPECIAL REQUIREMENTS FOR COMMERCIAL ENRICHMENT CONTRACTS IN 1975

1. TAKE OR PAY CONTRACTS FROM UTILITY CUSTOMERS.

2. ENRICHMENT CONTRACT DURATION - 25-YEAR MINIMUM - GENERALLY 30 YEARS.

3. CUSTOMER'S AGREEMENT TO PREPAY SEPARATIVE WORK UNIT (SWU) COSTS IN EVENT OF DELIVERY DELAY REQUESTED BY CUSTOMER AS WELL AS PAYMENT OF HANDLING AND STORAGE COSTS.

4. GOVERNMENT SWU STOCKPILE BACKUP.

5. GOVERNMENT TECHNOLOGY AND PROCESS AND EQUIPMENT WARRANTIES.

6. GOVERNMENT BUY-BACK OF TOTAL PLANT IF NOT COMPLETED.

7. PURCHASE BY GOVERNMENT FOR A SPECIFIC SWU REQUIREMENT.

8. GOVERNMENT AGREEMENT TO PURCHASE SWU'S IF THE COMMERCIAL CUSTOMER DEFAULTS AND SWU'S CANNOT BE MARKETED ELSEWHERE.

9. SPECIAL COMMERCIAL TERMS AND CONDITIONS, INCLUDING IDENTIFIED CONTINGENCY RESERVE IN SWU PRICES.

10. SPECIAL TERMINATION PROVISIONS TO PROTECT ENRICHER IF 50 PERCENT OF PLANT CAPACITY UNSOLD, LICENSING DELAYS, INABILITY TO OBTAIN NEEDED GOVERNMENT AGREEMENTS, ETC.

BASIC QUESTIONS

Any prudent company will seek the answer to certain basic questions before entering a new market or investing in a new product.

We have attempted to answer these questions about the market for uranium enrichment services from the standpoint of private industry in general.

BASIC QUESTIONS

- IS THE MARKET VIABLE AND GROWING?
- DO WE UNDERSTAND THE MARKET AND THE CUSTOMER?
- DO WE UNDERSTAND THE TECHNOLOGY?
- DO WE HAVE A GOOD PRODUCT?
- CAN WE COMPETE SUCCESSFULLY AGAINST THE ESTABLISHED COMPETITION AND REALIZE A SATISFACTORY RETURN ON OUR INVESTMENT?
- CAN WE ACQUIRE THE CAPITAL FUNDS REQUIRED WITH OR WITHOUT GOVERNMENT GUARANTEES AND SAFEGUARDS?
- WHAT ARE THE SPECIAL FACTORS INVOLVED?

MARKET CHARACTERISTICS

The market for uranium enrichment services (UES) is not a typical, commercial market. In some respects, it is similar to the military market because of the need to protect national security as well as the need to control nuclear weapons proliferation. As a result, the enrichment technology and the customers served are tightly controlled by the U.S. government.

Private industry is engaged in the military market in spite of the tight government controls. The UES market is much more highly capital intensive, however, and has only one unique product, whereas the military market consists of a multitude of products.

Assuming the U.S. government would no longer provide enrichment services, the competitors in the UES market are all foreign nationalized companies. Since these companies do not operate as private enterprises, U.S. private industry would be at a distinct disadvantage in competing against them.

Marketing and negotiating in the UES market has been performed by DOE. As a result, private industry, with the possible exception of nuclear reactor suppliers and architectural and engineering firms, has little knowledge and understanding of the UES market and customers.

There are a limited number of customers for the UES product. The latest available information indicates there are presently 280 operating nuclear plants, 255 under construction, and 141 planned, for a total of 676 nuclear plants worldwide. Of these, 169 are U.S. plants, 25 percent of the total plants and 30 percent of the total generating capacity.

Considering the current economic and energy environment and growing anti-nuclear public opinion, it is probable many of the plants under construction or planned will never be completed.

Many foreign countries desire to be self-sufficient with regard to UES for national security reasons and to avoid the type of problems experienced with OPEC. This is part of the motivation for the formation of URENCO and EURODIF and for the planned UES facilities in Brazil, Japan, and perhaps Mexico.

The UES market may also have a finite, limited life span because of the advent of breeder reactors. It is conceivable that, at some point in the future, when existing and planned nuclear reactors are decommissioned, there will be no further need for UES.

11-564 O—82—4

MARKET CHARACTERISTICS

THE MARKET IS NOT A TYPICAL, COMMERCIAL MARKET.

- U.S. GOVERNMENT CONTROLS TECHNOLOGY AND R&D.
- U.S. GOVERNMENT RESTRICTS MARKET OPPORTUNITIES.
- FOREIGN COMPETITORS ARE NATIONALIZED.
- ALL MARKETING HAS BEEN DONE BY U.S. GOVERNMENT.
- PRIVATE INDUSTRY HAS LIMITED KNOWLEDGE OF CUSTOMER.
- ANTI-NUCLEAR PUBLIC OPINION IS GROWING WORLDWIDE.
- FOREIGN COUNTRIES DESIRE TO BE SELF-SUFFICIENT.
- LIMITED NUMBER OF CUSTOMERS.
- BREEDER REACTORS MAY ULTIMATELY ELIMINATE THE MARKET.

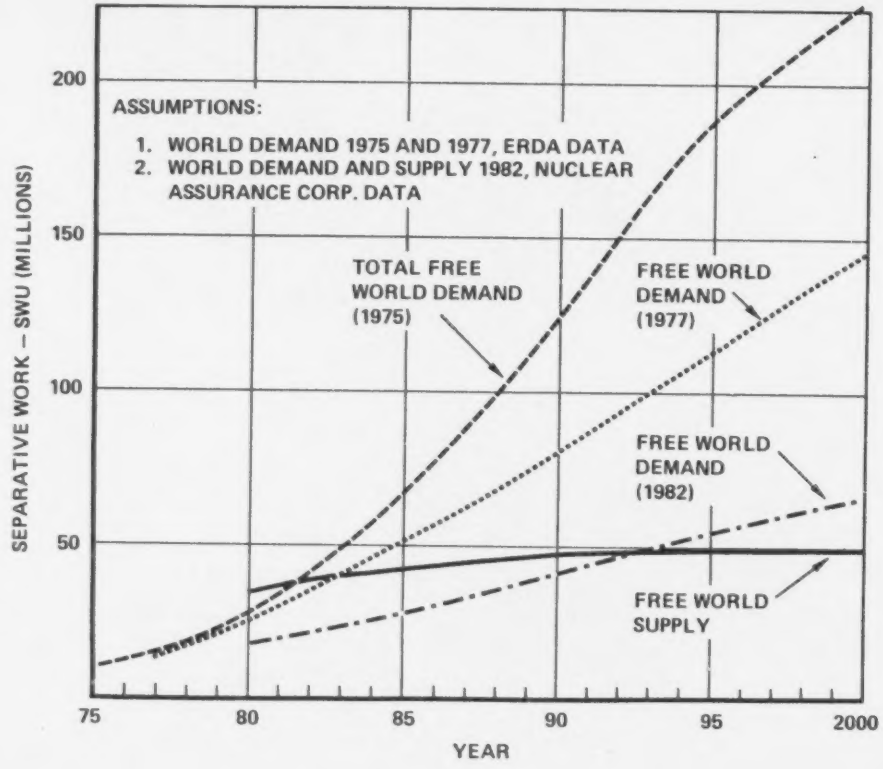
ENRICHMENT DEMAND

The chart on the opposite page illustrates historically the projections of enrichment demand from 1975 to the present. The optimistic projections for the use of nuclear power in 1975 created a projected demand for uranium enrichment of more than 200 million separative work units (SWU's) per year. Achieving this demand would have required bringing a new (approximately nine-million SWU) enrichment plant on stream every 12 to 15 months.

By 1977, as illustrated on the chart, the projections for nuclear power enrichment services had almost been halved. This was a direct result of conservation efforts resulting from the trauma of the OPEC oil embargo, anti-nuclear sentiment, the steadily increasing costs of nuclear generating stations, and a host of similar events that combined to dramatically slow the potential growth of nuclear power, particularly in the U.S.

The 1982 demand projection and the current enrichment supply forecast is also shown on the chart. It indicates existing free-world enrichment capacity will now be sufficient to supply the nuclear power marketplace until 1992 or 1993. After this period, new enrichment capacity will be required in the free world, and/or more modern technology plants will be required to replace older energy-intensive plants. The uncertainties of the enrichment marketplace, along with the projected but not yet proven breakthroughs in new modern technologies, combine to make future requirements and commercial enrichment plant possibilities very uncertain.

ENRICHMENT DEMAND - ANNUAL REQUIREMENT



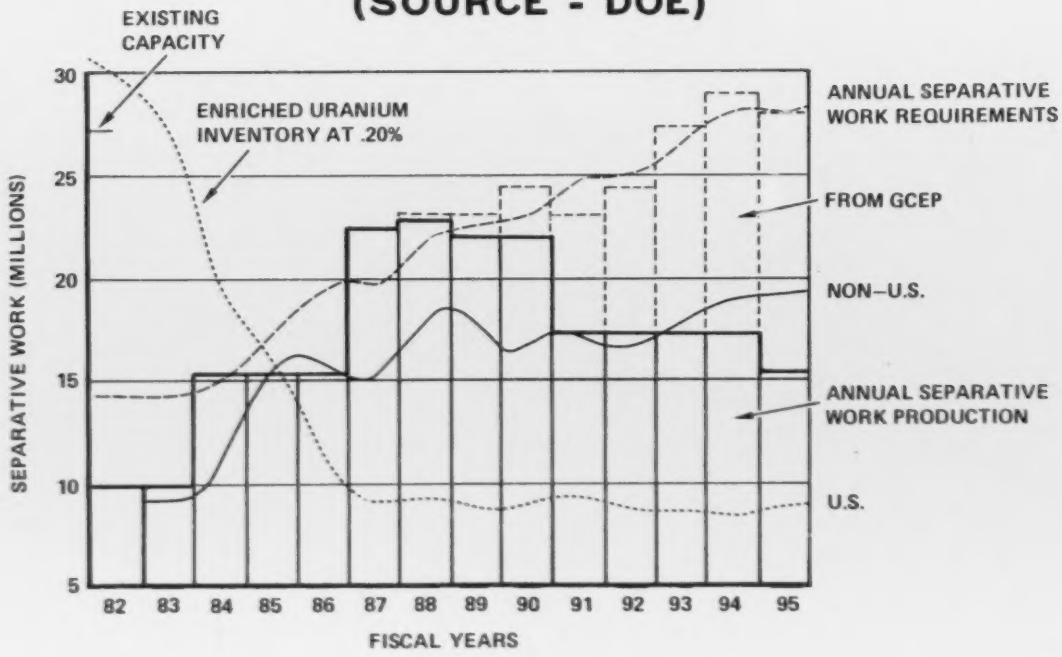
U.S. ANNUAL SWU PRODUCTION AND REQUIREMENTS

The chart on the opposite page represents the projected operating plan of the DOE enrichment complex through fiscal year 1995. Approximately one-third of the contractual requirements for separative work (SWU) come from non-U.S. utility customers. The average annual growth in requirements is three percent.

If the high cost and energy requirements of gaseous diffusion are overlooked, the chart shows that existing capacity can satisfy requirements until 1993.

The chart illustrates the U.S. plan to reduce existing inventories from more than 30 million SWU to approximately nine million SWU's over the next five years. It also indicates that, as the lower-cost GCEP production capability comes on stream, the supply of separative work from the gaseous diffusion complex gradually will be reduced. This action is planned in order to utilize the more cost effective gas centrifuge enrichment capability to the maximum extent possible, therefore lowering the composite price for separative work from the DOE complex to enhance the U.S. competitive posture in the U.S. marketplace.

U.S. ANNUAL SEPARATIVE WORK PRODUCTION AND REQUIREMENTS (SOURCE - DOE)



MARKET SUMMARY

The UES market is soft and sluggish. Energy conservation, which began in the mid 1970's, has been very effective. This - coupled with concerns for nuclear weapons proliferation, nuclear hazards, and nuclear waste disposal - has resulted in greatly reduced forecasts for nuclear electric power. In addition, the depressed economies in most countries have further reduced the demand for electric power.

As a result, both the U.S. and the worldwide UES capacity exceeds forecasted demand until the early 1990's.

In 1974, U.S. order books for enrichment services were closed because all available enrichment capacity was firmly committed. This encouraged the establishment of foreign enrichment services and has resulted in the formation of URENCO and EURODIF, plus planned capacities in Japan and Brazil.

When the U.S. order books were reopened in 1976, it was too late to prevent foreign competition. As a result, the U.S. share of the foreign UES market has declined from 100 percent in 1974 to about 35 percent today.

The plight of private uranium mining companies in the U.S. today is representative of what would have happened to private UES companies in the U.S. if the Nuclear Fuel Assurance Act had been passed by Congress in 1976.

50

MARKET SUMMARY

THE MARKET IS SOFT AND SLUGGISH.

- SINCE THE MID 1970'S, FORECASTS OF DEMAND HAVE BEEN DIMINISHING STEADILY.
- EXCESS WORLD ENRICHMENT CAPACITY EXISTS THROUGH 1992.
- EXCESS U.S. ENRICHMENT CAPACITY EXISTS THROUGH 1993.
- U.S. FOREIGN MARKET SHARE HAS DIMINISHED FROM 100 PERCENT IN 1974 TO ABOUT 35 PERCENT NOW.
- U.S. PRIVATE URANIUM MINING IS SEVERELY DEPRESSED AND HAS CONSIDERABLE EXCESS CAPACITY.

UNITED STATES COMPETITIVE POSITION

"The current uranium enrichment market is highly competitive with a limited number of near-term sales opportunities, all of which are outside the United States. The United States position in the non-United States market has declined from a 100 percent share in 1974 to about a 35 percent share today. A number of our foreign customers have switched from the United States to EURODIF, URENCO and the Soviet Union, and some new business has gone to these suppliers."

"Price has become a very important sales consideration to enrichment customers, and our competitors have met this need by offering price guarantees equal to or slightly less than the United States by pricing on an incremental basis. Our competitors' strategy has proven quite successful in weakening the United States greatest market advantage. Last year, the United States enjoyed a price advantage of $30 to $50 per SWU. Since then the United States price increased by $20, the competitors have reduced their price, and fluctuating exchange rates have further reduced our competitors' prices. Our competitors' strategy in FY 1981, noted previously, has placed them in a very strong position to capture new sales opportunities in Taiwan and Mexico worth more than $1.3 billion."

These paragraphs are quoted from material released when DOE representatives testified before Congressional committees in March 1982. These statements describe the difficulties the DOE enrichment plants are having in meeting world pricing competition.

Considering that private industry must make a profit (which DOE does not), must borrow funds at commercial interest rates considerably higher than U.S. Treasury interest rates, must pay Federal and local taxes, and normally would not have a low-cost SWU stockpile to draw from, it is difficult to see how private industry could compete successfully in the world market.

The current gaseous diffusion plants must be replaced with modern, cost-efficient technology if the U.S. is to compete in the future. The Gas Centrifuge Enrichment Plant (GCEP) currently under construction in Portsmouth, Ohio, will provide this cost-efficient technology. The present construction schedule, subject to the will of Congress and Presidential policy, will not be completed until 1993. In the meantime, successful competition against foreign suppliers is not feasible for a private U.S. supplier.

In addition, all existing foreign suppliers are nationalized. Their pricing policies are based on national rather than private interests. If necessary, the government may subsidize the operations and/or provide favorable financing terms to their customers. It is very difficult for U.S. private industry to compete against these conditions.

UNITED STATES COMPETITIVE POSITION

U.S. PRICES ARE MARGINALLY COMPETITIVE IN WORLD MARKET.

- EXISTING ENRICHMENT PRODUCTION FACILITIES ARE OBSOLETE; MAJOR INVESTMENT IN NEW TECHNOLOGY IS REQUIRED (EARLIEST IS GCEP - 1994).
- STRENGTH OF U.S. DOLLAR RESULTS IN UNFAVORABLE EXCHANGE RATE.
- DEMAND CHARGES FOR UNUSED TVA ELECTRIC POWER ARTIFICIALLY RAISE COSTS.
- NATIONALIZED FOREIGN COMPETITION.

CUSTOMER ACCEPTANCE

The enriched uranium supplied by the U.S. government is a good product of high quality. There has never been any question about customer acceptance of the product.

Many foreign customers do perceive the U.S. as an unreliable source. As a result, foreign enrichment sources have been established or other sources sought.

Closing the U.S. order books for UES in 1974, although required by U.S. law, was of great concern to foreign customers. The effect of this action was not unlike the OPEC oil embargo of the same period.

Various Administration and Congressional policies have also contributed to this unreliable perception by foreign customers. The U.S. nuclear non-proliferation policy implementation has been an irritant and obstacle to many foreign customers. The yearly battle-of-the-budget in Congress for GCEP funding has raised serious doubts that the U.S. will continue to be a low-cost supplier of UES.

CUSTOMER ACCEPTANCE

PRODUCT HAS GOOD ACCEPTANCE.

U.S. IS REGARDED AS UNRELIABLE SUPPLIER BY MANY FOREIGN CUSTOMERS.

- ORDER BOOK WAS CLOSED IN 1974, REOPENED IN 1976.
- ADMINISTRATION OF NON-PROLIFERATION POLICY.
- UNCERTAINTIES OF ADMINISTRATION AND CONGRESSIONAL POLICIES AND POLITICS.

GOVERNMENT INVESTMENT IN URANIUM ENRICHMENT SERVICES ACTIVITY (UESA)

The balance sheet on the opposite page for uranium enrichment services activities illustrates the tremendous size of government investment as well as the fact the net government investment increased 5.4 percent from 1980 to 1981.

Uranium enrichment is a capital-intensive industry, not unlike the electric utilities that it serves. The value of inventory relative to sales is unusually high, however, in comparison with electric utilities and industrial firms.

URANIUM ENRICHMENT SERVICES ACTIVITY

Exhibit I

Balance Sheet

	Sept. 30, 1981	Sept. 30, 1980
Assets	(thousands)	
Cash (note 1)		
Funds in U.S. Treasury	$ 635,873	$ 837,163
Cash with contractors	11,334	4,322
	647,207	841,485
Accounts receivable		
Trade, domestic	346,983	230,580
Trade, foreign	116,966	146,363
	463,949	376,943
Inventories (note 2)		
Uranium		
Separative work (schedule A)	1,899,553	1,790,445
Feed material (note 3)	1,716,759	1,760,249
	3,616,312	3,550,694
Production stores and process spare parts (net)	45,835	42,378
	3,662,147	3,593,072
Plant (schedule B)		
Completed plant and equipment	3,531,030	3,268,295
Less - Accumulated depreciation	1,715,578	1,639,369
	1,815,452	1,628,926
Construction work in progress	1,150,411	919,927
	2,965,863	2,548,853
Prepayments and deposits	4,763	5,828
Total assets	$7,743,929	$7,366,181
Liabilities and Government Investment		
Accounts payable and accrued expenses	$ 124,972	$ 107,645
Deferred credits (note 4)	455,788	466,480
Total liabilities	580,760	574,125
Government investment (exhibit III)	7,163,169	6,792,056
Total liabilities and Government investment	$7,743,929	$7,366,181

Notes 1 through 11 following the exhibits are an integral part of the financial statements.

INCOME FROM DOE URANIUM ENRICHMENT SERVICES ACTIVITY (UESA)

The income statement on the opposite page indicates a slight profit was realized in 1980, while a sizable loss was incurred in 1981. It is realized that government regulations dictate only cost recovery and not operation at a profit.

The following changes in 1980 to 1981 are significant:

Sales increased 4.8 percent

Cost of sales increased 24.2 percent

Operating expense increased 16.2 percent

Interest increased 30.5 percent -17%

81 - 11.335%
80 - 9.685%

58

URANIUM ENRICHMENT SERVICES ACTIVITY **Exhibit II**

Income Statement

	Fiscal Year Ended Sept. 30, 1981 Amount (thousands)		Fiscal Year Ended Sept 30, 1980 Amount (thousands)	
Revenues:				
Enriching services (note 5):				
Domestic, trade		$ 748,217		$ 770,905
Foreign, trade		440,176		453,457
DOE programmatic activities		147,334		79,715
		1,335,727		1,304,077
Feed sales (note 3):				
Domestic, trade		22,963		15,664
Foreign, trade		24,273		19,770
DOE programmatic activities		61,777		39,652
		109,013		75,086
Gross revenue		1,444,740		1,379,163
Cost of sales:				
Separative work		732,172		591,024
Feed material (note 3)		42,298		32,086
		774,470		623,110
Gross margin		670,270		756,053
Operating expense:				
Process development:				
Centrifuge	$ 61,843		$ 61,652	
Diffusion	15,198		15,019	
Advanced isotope separation	64,115	141,156	44,230	120,901
Processing tails and storage		1,871		1,594
Preparation of materials for shipment		4,617		3,498
DOE administration		15,835		15,946
Security investigations		2,892		2,651
Community support		2,141		1,751
Engineering and planning studies		12,332		9,637
Depreciation expense (note 6)		14,888		14,989
Interest on advance payments (note 4)		44,979		38,116
All other expenses and adjustments		3,354		1,276
		244,065		210,359
Net operating income		426,205		545,694
Loss on asset retirements from Cascade Improvement Program (note 7)		6,529		8,467
Net income before interest		419,676		537,227
Interest on Government investment allocated to current operations (note 8)		683,907		523,723
Net income (loss)		$(264,231)		$ 13,504

FINANCIAL COMPARISON OF UESA VERSUS U.S. MANUFACTURING INDUSTRIES

The table on the opposite page indicates that the annual turnover of total investment compared to sales for UESA is very much less than for the U.S. manufacturing industry. This is primarily due to the government investment in plant, equipment, and inventory.

UESA is recognized as a capital-intensive industry, similar to electric utilities, and the lower turnover in plant and equipment is to be expected. In fact, the .49X turnover for UESA is better than the .38X turnover of plant and equipment achieved by Commonwealth Edison of Chicago in 1981.

The low inventory turnover is peculiar to UESA, however. The UESA operating plan (refer to Page 15) indicates the SWU inventory will be reduced to about nine million SWU by 1987 and maintained at this level through 1995. This would improve the turnover in financial SWU inventory but does not necessarily reduce the feed material inventory. The amount of feed material inventory, which has more leverage than SWU inventory on the turnover rate, may be a part of national policy and not subject to normal business inventory control.

The UESA R&D, or process improvement, costs as a percent of sales are nearly five times the average for industry. This could present serious problems in maintaining profitability as a private enterprise.

11-564 O—82——5

1981 URANIUM ENRICHMENT SERVICES ACTIVITY (UESA)

VS

AVERAGE OF ALL U.S. MANUFACTURING INDUSTRIES

	UESA	INDUSTRIES*
TURNOVER RATIOS COMPARED TO SALES:		
INVENTORY	.39X	7.10X
ACCOUNTS RECEIVABLE	3.11X	8.70X
NET PLANT AND EQUIPMENT	.49X	3.66X
TOTAL INVESTMENT	.20X	2.82X
PERCENT TO SALES		
R&D EXPENSE (PROCESS IMPROVEMENT)	9.8%	2.0%

*Source: Quarterly Financial Report, December 1981, Federal Trade Commission.

CONSIDERATIONS FOR TRANSFER TO THE PRIVATE SECTOR

In view of the many special factors involved and major differences between government and private operation of uranium enrichment services (UES), special conditions must be considered for transfer of these operations from the government to the private sector. These conditions, some of which are presented herein, would involve lengthy and complex negotiations between the government, both DOE and Congress, the utility customers, financial institutions, and the commercial operator (CO).

All existing DOE contracts for UES must be transferred to the CO without termination in order for the operator to generate the cash flow and profits required to continue operations.

Favorable terms are needed for the transfer of ownership of plant and equipment in order not to burden the CO with heavy interest debt that would preclude profitable operations.

Existing SWU and feed material inventory must be retained by the government to be drawn down at cost by the CO as required. This would assure the customers of a backup inventory and will avoid the necessity for the CO to carry an unacceptably high inventory.

A minimum SWU and feed material inventory must be retained by the government consistent with national interests and as an emergency backup inventory for the CO.

The government must complete the centrifuge enrichment plant currently under construction. This will assure the new technology required for low-cost production in the 1990's, while avoiding the crushing effect of interest expense on the CO. This plant would then be transferred to the CO on favorable terms.

The government must transfer sole rights to all existing and planned enrichment technologies to the CO at no cost. This would provide the CO the basis for maintaining a worldwide competitive position, now and in the future. Suitable government warranties would be required for the centrifuge technology, since it has not yet gone into production.

The CO must become responsible for R&D, or process development, activities without government restrictions, except as to security. Government development facilities must be transferred to the CO for this purpose. This will enable the CO to pace R&D investment and introduction into operations in concert with the market requirements and the retirement of older facilities.

All U.S. enrichment activities must be placed under one CO. The operations of existing gaseous diffusion plants are interdependent and must be under one direction. Because of the huge capital investment required, comparable to electric utilities, the CO must have protection against domestic competition.

CONSIDERATIONS FOR TRANSFER TO THE PRIVATE SECTOR (Cont'd)

The CO must have complete freedom to establish prices for UES in accordance with U.S. law but independent of the Atomic Energy Act and U.S. politics. This is necessary for profitable, competitive operations.

In order to obtain the financing required, the CO must have protection against changes in national policy that could seriously diminish the profitability of UES. Similarly, the financial community will want some type of government guarantee on borrowing and guarantee of a suitable return on investment. In some respects, the privately operated UES could be considered a national utility and national resource.

The $500,000,000 indemnity against nuclear incidents provided in the Price-Anderson Act of 1957 must be significantly increased in order to provide realistic coverage in today's escalated dollars. In addition, the definition of a nuclear incident in this act must be clarified and broadened to cover liability resulting from an incident causing damages to the public, even though there is no actual radiation release.

The government must establish a national program for the storage and disposal of nuclear waste. This will assure the future health of the nuclear industry by diminishing public opposition and by removing the uncertainties inherent in the electric utilities' responsibility for nuclear waste disposal.

In order to compete successfully against foreign nationalized competition, the CO will require suitable local and federal tax concessions.

Finally, DOE must take the initiative to secure agreements to the above conditions from Congress and the utility customers.

CONSIDERATIONS FOR TRANSFER TO THE PRIVATE SECTOR

- TRANSFER OF ALL EXISTING CONTRACTS TO THE COMMERCIAL OPERATOR (CO).
- FAVORABLE TERMS FOR TRANSFER OF OWNERSHIP OF PLANT/EQUIPMENT.
- GOVERNMENT RETENTION OF SWU/FEED INVENTORY; SELL TO CO AT COST AS REQUIRED.
- GOVERNMENT COMPLETION OF GCEP AND TRANSFER TO CO.
- GOVERNMENT TRANSFER OF ALL EXISTING AND PLANNED TECHNOLOGY TO THE CO AT NO COST, WITH SUITABLE WARRANTIES.
- ASSUMPTION OF R&D RESPONSIBILITY BY THE CO.
- A SINGLE-SOURCE COMMERCIAL OPERATOR.
- CO SETS THE PRICES FOR ENRICHMENT SERVICES.
- PROTECTION AGAINST CHANGES IN NATIONAL POLICY.
- A GUARANTEED RETURN ON INVESTMENT AND GOVERNMENT LOAN GUARANTEES.
- BROADER, INCREASED INDEMNIFICATION OF THE CO IN CASE OF NUCLEAR INCIDENT.
- U.S. MUST HAVE A NATIONAL WASTE PROGRAM IN BEING.
- SUITABLE TAX CONCESSIONS FOR THE CO.
- DOE MUST TAKE ACTION WITH CONGRESS AND UES CUSTOMERS TO PROVIDE THE ABOVE.

CONCLUSIONS REGARDING PRIVATIZATION OF URANIUM ENRICHMENT SERVICES

Many factors peculiar to the production and marketing of uranium enrichment services (UES) combine to make UES a non-viable opportunity for private industry.

The market is narrow and variable, having one product with a limited number of customers and major uncertainties in demand. In addition, national security and nuclear non-proliferation objectives make the industry subject to the vagaries of U.S. politics.

The investment in plant, equipment, and inventory is excessive in relation to the sales potential. The annual turnover of this investment is considerably less than for U.S. manufacturing industries, as shown on Page 27. It is highly unlikely, therefore, that private industry could realize a satisfactory return on investment.

In order for UES to be considered as a potentially feasible opportunity for private industry, Congress must pass specific enabling legislation. This legislation would have to provide government guarantees and safeguards against market conditions peculiar to UES. In some respects, industry would have to be treated as a national utility. Congress was unwilling to pass similar legislation in 1976, and there is little assurance Congress would be willing to pass such legislation now or in the near future.

Assuming the privately operated UES would be required to serve national defense, the government must, of necessity, retain the right to set operating priorities, even in peace time. This would occasionally interfere with industry's objectives.

U.S. private enterprise is at a distinct disadvantage in competing with existing foreign nationalized enrichment industries that set pricing and marketing objectives on other than a profit basis. Since the foreign market is projected at approximately 70 percent of the world market, this is a significant obstacle for private industry.

In summary, privatization of UES was unsuccessful in 1976 after considerable study, evaluation, and negotiation between industry, ERDA, and government. Privatization is even less feasible today in view of the depressed market, nationalized foreign competition, high interest rates, scarcity of capital funds, and the potential advent of new enrichment technology and the breeder reactor.

CONCLUSIONS

PROVIDING URANIUM ENRICHMENT SERVICES DOES NOT APPEAR TO BE A VIABLE BUSINESS OPPORTUNITY FOR PRIVATE INDUSTRY.

- MARKET IS NARROW AND VARIABLE; SUBJECT TO UNCERTAINTIES OF U.S. POLITICS.
- INVESTMENT IS EXCESSIVE IN COMPARISON TO POTENTIAL REVENUES.
- SIGNIFICANT CONGRESSIONAL ACTIONS ARE REQUIRED TO MAKE COMMERCIAL FEASIBILITY POSSIBLE.
- DEFENSE REQUIREMENTS WILL NECESSITATE GOVERNMENT PRIORITY ON OPERATING PLANS.
- U.S. PRIVATE ENTERPRISE CANNOT COMPETE WITH FOREIGN NATIONALIZED SUPPLIERS, WHO MAY SET PRICES ON OTHER THAN A PROFIT BASIS.

Senator DOMENICI. You contend that the enrichment demand is not the most important variable in analyzing the economics of GCEP. Is that correct?

Dr. BREWER. It is quite important, Mr. Chairman, but the central feature of the enrichment strategy plan is to reduce the power requirement for enrichment services. In other words, to displace as soon as you can the large power cost. That is more important, and is a larger, more dominant factor than demand.

Senator DOMENICI. I understand. But the things you mentioned or that you say are more significant are the date and cost of the AIS, power cost escalation, general inflation and GCEP costs. I think those are generally the ones.

Dr. BREWER. Yes, sir.

Senator DOMENICI. The problem I have is that I do not see a general analysis that incorporates all of those sensitivities into some kind of a model that would show us, take the different assumptions on those to prove your point. It seemed to me you ought to be able to do that.

Dr. BREWER. We can provide that, Mr. Chairman. We have a 1980 strategic plan analysis which is about an inch thick and that was updated in December 1981. It is a rather complex subject, but we will be happy to boil it down in summary fashion for this committee, for the record.

Senator DOMENICI. But can you quantify each of those components in some way that we can understand?

Dr. BREWER. Yes, sir.

Senator DOMENICI. That is what we need.

Dr. BREWER. We run a number of production scenarios with and without GCEP with different schedules or assumptions for GCEP, different assumptions on when AIS could come online, and different cost assumptions. For each case we generate a number of parameters; the total cost to the Government, the taxpayer, the total cost to the customer, the impact on our foreign market share and domestic market share and other such parameters.

Senator DOMENICI. What I am getting at, if you can, I think a table that attempted to put each of those items into some kind of form that we can look at and conclude from and talk about, I think that would be very helpful.

Dr. BREWER. We will be happy to provide that.

Senator DOMENICI. And make that a part of what you will add to the record also.

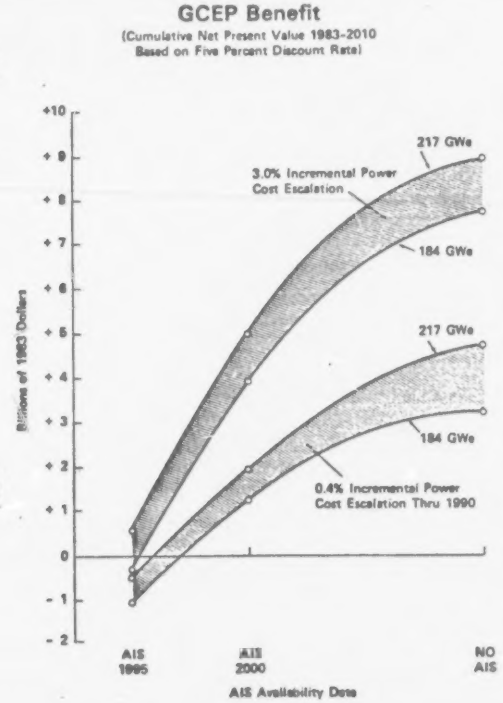
Dr. BREWER. Yes, sir.

[The information follows:]

]SENSITIVITY ANALYSIS OF GCEP[

The following illustrates the sensitivity of (GCEP) economics to various parameters including demand, Advanced Isotope Separation (AIS) plant availability date and costs, power cost escalation, general inflation and GCEP costs.

The following figure shows the net present value economic benefits of GCEP for the period 1983 to 2010 as a function of demand, power cost escalation and AIS availability date. In this analysis, the assumptions used are primarily those recommended by GAO in their May 25, 1982, report "Issues Concerning the Department of Energy's Justification for Building the Gas Centrifuge Enrichment Plant."



The lower shaded band in the figure shows the net present value 1983 dollar benefit (+) or penalty (-) for constructing GCEP as a function of AIS availability date based on (1) demands associated with a range of 184-217 GW by 2000 (as recommended by GAO), (2) incremental power cost escalation of 0.4 percent through 1990 and none thereafter (as recommended by GAO), and (3) a 5 percent discount rate (as recommended by GAO). The upper shaded band uses the same assumptions as in the lower band except that incremental power cost escalation of 3 percent per year is assumed throughout.

Inspection of the figure illustrates several points. The demand effect (width of the shaded bands) on discounted GCEP benefits ranges from $0.5 to $1.6 billion. The AIS availability date effect is far more pronounced. The swing in discounted GCEP economic benefits from where AIS is totally successful and available for production in 1995 to where no AIS plants are built ranges from $3.1 billion (184 GW demand, low power cost escalation) to $8.7 billion (217 GW demand and high incremental power cost escalation). The power cost escalation effect is also very pronounced. The swing in discounted GCEP economic benefits from where incremental power cost escalation is 3 percent to where incremental power cost escalation is 0.4 percent through 1990 and zero thereafter ranges from $0.7 billion (184 GW and AIS available in 1995) to $4.55 billion (184 GW and no AIS).

GCEP and AIS costs are also significant. Assuming a 10 percent increase in the GCEP cost estimate, as suggested by GAO, decreases the GCEP cost benefit, at a 5 percent discount rate, by $0.66 billion. Increasing the AIS cost estimate by 10 percent would increase campaign costs, discounted at a 5 percent rate, by $0.53 billion.

The above did not investigate the effect of inflation. Inflation tends to favor gas centrifuge over gaseous diffusion. The gas centrifuge is extremely capital intensive and these costs, once sunk, are no longer subject to inflation. The bulk of gaseous diffusion plant costs, on the other hand, are associated with power purchases and are totally subject to inflation.

The effect of inflation can be illustrated by comparing the incremental unit costs of production of the existing gaseous diffusion plants (GDPs) and GCEP over time as shown in the following table. The unit costs are calculated based on the following assumptions:

Capital Amortization - 25 years
Interest Rate - 11 percent
Interest on construction is expensed
GCEP capacity - 13.2 million SWU

GCEP UNIT COSTS
$/SWU

	8 Bldgs
Full cost (FY 83 $)	$ 81
Incremental cost	
FY 83 $	64
	(88)
ESC to 1996 @ 9%	130
	(270)
Above + 3% higher power	133
	(384)

( )* comparable diffusion cost.

NOTE: Assumes 13.2 million SWU of GCEP capacity.

The $81/SWU full cost includes the entire capital cost ($6.95 billion) for GCEP in FY 1983 dollars. The $64/SWU GCEP incremental cost excludes sunk costs. These are costs that have been incurred or commitments that have been made where the cost will be incurred even if the GCEP is terminated. These costs are excluded in the cost comparison because they have been spent and decisions should be based on minimizing future costs. GDP sunk costs include all construction costs. Thus, in the unit cost comparison the capital cost for GDPs is zero and from GCEP a total of $1.5 billion is sunk. The $88/SWU in brackets is the incremental cost (in FY 1983 dollars) of producing the last 13.2 million SWU from the existing gaseous diffusion plants and is essentially all power cost related. As shown, the incremental GCEP unit cost is about 70 percent of the incremental cost of existing diffusion capacity ($64/SWU versus $88/SWU) in FY 1983 dollars.

Inflation rates significantly impact the unit cost comparisons. For the GDPs the entire unit cost is subject to inflation since we are not including sunk costs. Power costs which represent almost all of the GDP costs have been particularly vulnerable to inflation. For the period 1970 through 1980, the unit cost of power to the GDPs increased an average of 18 percent per year or about 10 percent above the general inflation rate. For this analysis we assumed a general inflation rate of 9 percent and power cost escalation rates of 9 and 12 percent. The latter power cost escalation rate is 3 percent above the assumed general inflation rate of 9 percent. GCEP construction costs are assumed to increase at a rate of 9 percent per year, but this impact is not as great as first might be expected. For example, construction costs in FY 1984 are subject to only 1 year of inflation; FY 1985 costs to 2 years, etc. The non-power operating costs for the GDPs and GCEP are assumed to be 9 percent.

As shown in the table, the effect of inflation is significant. At a nine percent inflation rate and a nine percent power cost escalation rate, the unit cost of GCEP production in 1996 is $130/SWU versus $270/SWU from existing gaseous diffusion capacity. If power costs would increase at a rate 3 percent greater than the general inflation rate, then the unit cost of GCEP would be $133/SWU or 35 percent of the $384/SWU unit cost from existing gaseous diffusion capacity.

Senator DOMENICI. I have some additional questions, but I will yield to Senator Ford now.

Senator FORD. I will be happy to yield to the distinguished Chairman.

The CHAIRMAN. Thank you, but go ahead.

Senator FORD. I have two or three questions and I am going to get away maybe from some of the integral parts and talk a little bit about the installations and things of that nature, which I might have a little more interest in than some others here.

Dr. Brewer, have you or your organization performed any analysis of which of the three gaseous diffusion plants may be retired first if GCEP is built and if the demand for enrichment services does not then warrant continued operation of all three diffusion plants?

Dr. BREWER. First of all, we would not contemplate retiring any diffusion plants unless and until the first train of GCEP were operating, and operating well. As to which of the three diffusion plants would likely be retired, Mr. Voigt, do you have a view?

Mr. VOIGT. We have not analyzed specifically which of the three plants could be shut down. What we have looked at thus far, Senator Ford, is within the frame work of our existing operating plans. We have not considered specific shutdown, but operating all three plants at reduced power levels.

But as of this date, we have not looked at any of the sites as to which would be the better one to shut down, if we were to shut one down.

Senator FORD. When does that first train go into effect, to see if it operates and operates well, as you stated?

Mr. VOIGT. It begins operation in 1985.

Senator FORD. 1985?

Mr. VOIGT. Yes, sir.

Senator FORD. So we are 2½ years away from putting that into place?

Dr. BREWER. Yes, sir.

Senator FORD. If the Federal Government builds a centrifuge capacity beyond that currently contemplated in GCEP, what is the likelihood that the additional capacity would be built at other existing sites currently operating as diffusion plants?

Dr. BREWER. I would feel, Senator Ford, that there would be a compelling case for dispersing the gas centrifuge capacity, not put it all in one, at one site and vulnerable to a single event or single attack, be it war or a natural disaster.

Senator FORD. So what you are saying then is in all likelihood you would disperse the operations to several locations?

Dr. BREWER. I think that would be a valid and prudent strategy, Senator.

Senator FORD. I think it is obvious to us here that the DOE supports GCEP. Is that same support there from the White House?

Dr. BREWER. Yes, sir.

Senator FORD. It is?

Dr. BREWER. Yes, sir. We will attest to that.

Senator FORD. Mr. Chairman, I have no further questions at this time.

Senator DOMENICI. Do we take it that you are content to rest your case with White House support?

Senator FORD. Well, not necessarily. My daddy always told me that faith without work is dead and I intend to have more than just faith, Mr. Chairman.

Senator DOMENICI. You are a great Christian.

Senator FORD. Well, I attempt to be. I am a Baptist and they say once saved always saved and I believe in that and ultimately hope it is true.

Senator DOMENICI. We all do. Senator McClure.

The CHAIRMAN. Thank you very much, Mr. Chairman. Mr. Secretary, I appreciate your statement today. There are two or three things that perhaps we can focus on in addition to the questions that have been asked. Senator Domenici and Senator Ford have explored most of the areas of question.

But one that is of concern to every person that is involved in this industry has to lie on the availability and demand for uranium ores. On page 13 of your testimony you state and I quote, "DOE could avoid building additional enrichment capacity through fiscal year 1995 by operating the gaseous diffusion plants starting in fiscal year 1983 at full capacity."

How much uranium would be consumed on a daily basis by the uranium enrichment complex operating at full capacity?

Dr. BREWER. The raising of the tails assay, Senator McClure, would require more makeup yellow cake or mined uranium. The exact figure I think Mr. Voigt has, the two figures for it.

Mr. VOIGT. I do not have the exact quantity, Senator McClure, that would be required. In going from a two-tenth tails assay, which we are now currently transacting at, say, to a 0.25 tails assay, would increase the requirement, as I recall, about 10 percent. I would like to supply the detailed numbers for the record on the annual basis, if I may.

The CHAIRMAN. Would I be close if I said approximately 100 tons a day?

Mr. VOIGT. I will provide that for the record, Senator.

[The information follows:]

URANIUM REQUIRED TO OPERATE ENRICHMENT COMPLEX AT FULL CAPACITY

Operating the existing uranium enrichment complex at full capacity at the current tails assay of 0.2 percent U-235 requires just under 125 short tons of U_3O_8 equivalent per day. Increasing the tails assay to 0.25 percent U-235 has a twofold effect on uranium requirements. First, about 9 percent more uranium is required per unit of enriched product. Second, about 13 percent more enriched product can be made for a fixed amount of separative capacity as less separative work is needed per unit of product at the higher tails assay. Hence just over 150 short tons of U_3O_8 equivalent per day (an increase of about 23 percent) would be needed to operate the existing enrichment complex at full capacity at a tails assay of 0.25 percent U-235.

Dr. BREWER. That is about right.

The CHAIRMAN. What impact would full capacity operation of the uranium enrichment complex have on the mining industry if the entire feed for the complex were derived from ore yet to be mined?

Dr. BREWER. Well, certainly if you, one, raise the tails assay and, two, raise the capacity factor for the three diffusion plants from 35 percent to 100 percent, the mining industry, and the mining re-

quirements are going to go up in a very major fashion. But what I can't get a grip on, Senator, is who the customer is.

Does the Federal Government purchase the yellow cake and then enrich it and then stockpile it?

The CHAIRMAN. We have to look either to the domestic uranium sources to feed that complex or we have to buy uranium overseas. The question then becomes which is the better U.S. policy. That is integral to this discussion as to how much enrichment capacity we will have because you have to enrich something.

You just do not run these plants without having feed go into them. The point I would make is that we do not now have domestic mining industry sufficient to supply the uranium that will be required if indeed we run those complexes at full capacity. Then we have to start looking at whether we import the uranium from other sources or whether we start developing a domestic mining industry.

Let me go from that for a moment to another question. GAO used your projections. They appear on page 3 of the GAO report, projections for demand. And I find no reason to question those projections. I think they are lifted straight from GAO figures. Is that not correct?

Dr. BREWER. Yes, sir. Those are our figures.

The CHAIRMAN. And what that table shows is the dramatic decline in expected consumption or demand for enrichment services between the time that the Portsmouth add-on plant was authorized in December 1975 to August 1981. Those are the dates used in that particular table.

Dr. BREWER. Yes, sir, there has been a very drastic change.

The CHAIRMAN. That drastic change is produced by two factors. One is the reduction in the number of plants to be built in the United States.

Dr. BREWER. Yes, sir.

The CHAIRMAN. And the other is the reduction in expected overseas demand for enrichment services.

Dr. BREWER. Yes, sir. Since 1975 there have been no new orders in the United States and about 50 plants have fallen out of the pipeline.

The CHAIRMAN. I think I would be correct in saying that in 1975 when GCEP was authorized, the demand figures of 26 as compared to the present of 10.8, the demand figures for 1980 through 1988 as shown in that table, were based upon plant demand in this country and expected demand for enrichment services overseas. It was also contemplated at that time that we would continue to run the gaseous diffusion plants in addition to GCEP. Is that correct?

Dr. BREWER. Yes, sir.

The CHAIRMAN. What you are suggesting now is that there will be a substantial substitution of GCEP for gaseous diffusion.

Dr. BREWER. Yes, sir. That is the central feature, as I said, of the strategy. Let me say this, Senator. Let's start with the demand as we see it now or the contracts that we hold now. We have contracts which would fully saturate the diffusion plant complex and the GCEP complex, all eight buildings.

Now, admittedly, we expect many of those contracts to be terminated or deferred. Nevertheless, let us take the extreme case. Let

us suppose for the sake of argument that we have contracts only enough to saturate the capacity of the diffusion plant complex, GCEP would still be a justified project in its ability to reduce the power requirements; and the SWU demand has not dropped to that point yet.

The CHAIRMAN. Well, I question where we will be 20 or 30 years from now, but at least we have a pretty accurate prediction of where we will be over the next 10 years, because it takes that much time to change the scene very much, at least changes in terms of additional plant demand or additional plant capacity.

If we were to have a dramatic change in direction right now, it would not be reflected within the next 10 years with the demand in the next 10 years.

Dr. BREWER. That is right.

The CHAIRMAN. Does this table that is used here contemplate reprocessing and the use of mixed oxide fuels in commercial reactors?

Dr. BREWER. No, sir. I believe this table was prepared on the basis of a once through fuel cycle which would tend to, if you assume recycle, would tend to reduce the SWU requirement.

The CHAIRMAN. And, again, that is nothing that can possibly affect the next 10 years, but might affect something 15 or 20 years or beyond from now?

Dr. BREWER. Yes, sir.

The CHAIRMAN. Does this table indicate or can you state anything with respect to the administration's position to the aggressiveness of U.S. policy and nonproliferation?

Dr. BREWER. Our nonproliferation policy, Senator, has been liberalized somewhat from the previous administration. We are aggressively, as Mr. Voigt can tell you, marketing enrichment services abroad. We just signed contracts with the Egyptians for $1.5 billion. Also, we are aggressively marketing in Mexico and Yugoslavia as well and Taiwan, et cetera.

As you may remember in 1974 we had 100 percent of the world market in enrichment. We have now only 35 percent. We are trying to restore our position.

The CHAIRMAN. Do you recall what the projection was for Japanese demand for enrichment services outside of their own capacity?

Mr. VOIGT. In terms of gigawatts, Senator? I do have that, but I am going to have to look for it, the framework, if I can supply that for the record.

The CHAIRMAN. If you can do so, I would appreciate it. I don't ask these questions to cast doubt on GCEP but to cast doubt upon total U.S. policy. Those are some aching voids in policy. We are still hoping that somehow reprocessing will come in in this country. We are putting right now a kind of undefined hope that the private sector will pick that up and run with it. At that same time we have no developed policy with how we will deal with it if they were to attempt it.

Is that correct?

Dr. BREWER. Yes, sir. You speak my thoughts exactly.

[The information follows:]

JAPANESE DEMAND FOR ENRICHMENT SERVICES

In April of this year Japan announced a new nuclear power growth target for the years 1990 and 2000. The 1990 goal is for 46 gigawatts while the 2000 goal is for 90 gigawatts. DOE is currently planning on supplying enrichment services to Japanese utilities for nuclear power plants with capacity totaling about 42 gigawatts in fiscal year 1995, decreasing to about 38 gigawatts in fiscal year 2000.

The CHAIRMAN. And I rather suspect the private sector is not very eager to get involved in an area like this where there is undefined policy.

Dr. BREWER. Three times, as you know, Mr. Chairman, the private sector has attempted to get into reprocessing and three times they have been frustrated by instabilities in Federal policy. So it is unlikely that they will come to the well again.

The CHAIRMAN. I am very concerned about it, because while we have been deluding ourselves about U.S. influence on international nonproliferation policy, the rest of the world has gone ahead and done their own thing without us. We have had perhaps more influence over Japanese policy than we have over the French or West Germans and certainly the Russians and, yet, the Japanese, the ones over which we have exerted the most benign influence, are moving ahead with new processing facilities, as the Secretary knows; Not only do they have the To-Tie plant, but they have broken ground for one five times as large.

Dr. BREWER. 1,500 metric tons.

The CHAIRMAN. That is right and they are preparing to reload commercial reactors with mixed outside fuels as early as 1990 out of the To-Tie plant. That greatly changes the world equation with respect to demand for enrichment services. Does it not?

Dr. BREWER. Yes, sir.

The CHAIRMAN. And we are doing nothing about reprocessing fuel, virtually nothing.

Dr. BREWER. We are trying very hard, Mr. Chairman, within the frame work of other considerations to put in place a reprocessing policy in this administration, which falls somewhat short of a pure entrepreneurial venture but does not entail total Federal acquisition of a reprocessing plant, something in between.

The CHAIRMAN. And finally the nonproliferation policy, if we are really concerned about the buildup of available plutonium in the form of spent fuel rods, which is what we talked about, we are very concerned that somebody is going to have spent fuel rods around and they are going to be able to take plutonium out and they are going to make bombs.

It has appealed to me that it is a much easier thing to do to give them enrichment services and provide fuel rods under contract and return those fuel rods in our own custody with or without reprocessing in this country. They are not going to sit on the fuel rods any more than the Japanese are for economic or commercial reasons, let alone the other question that so bedevils the world about the proliferation of plutonium and the availability of plutonium for weapon purposes.

Sometime this country will come to its senses and recognize that is not just going to go away, that sometime we are going to have to look at the entire fuel cycle and get the elements of the fuel cycle

back under our control as the best guarantee for the security of the United States and, indeed, of the entire world.

And, yet, we have been so paralyzed by fear that we just seem to close our eyes and say go away, go away, as though it is going to happen if we say go away. And it does not go away. It is not going away.

If indeed my expectation is correct, if we do nothing about reprocessing, nothing about international fuel contracts that deal with return of the spent fuel rods, we will progressively eliminate ourselves from foreign markets in which those considerations become important for foreign governments.

Dr. BREWER. And in fact, Mr. Chairman, drive the foreign Third World market to vendors who are less careful about proliferation matters than we are.

The CHAIRMAN. Absolutely and I am concerned because here we are debating one small item of a very large and very important picture. People are apt to look at this in terms of focusing on individual aspects of the picture without seeing the total picture.

If we are to be aggressive in the nonproliferation policy that was designed to give the world as great a security as we could give it, we would be going all out on the maintenance of a fuel supply feasibility, including GCEP and aggressive policy and reprocessing and aggressive marketing, demanding return of spent fuel elements to this country, guaranteeing the best economic deal because they are not going to deal with us just because we want them to.

We are going to have to be able to do it on economic terms. That means in my mind to build GCEP but there are real questions to ask ourself as to whether we need all of the enrichment capacity if we are not going to do any of the other things and if the rest of the world is going to be doing all of the rest of the other things.

Japan is not the only one that is going to be fabricating mixed oxide fuel. It will not be very many years before others are and they will be moving into the fuel rod market with mixed oxide fuels, while we are sitting here saying, oh, isn't that awful.

I hope we can get some kind of a cogent picture that does not just center in DOE or just focus on one element. I would like to see even some people in the State Department understand some parts of that problem, as well as the Congress, I might add.

Mr. Chairman, I have no further questions.

Senator DOMENICI. Senator McClure, I have to go down to the Subcommittee on Water to testify for about 5 minutes. I wonder if you could Chair for me.

The CHAIRMAN. Yes.

Senator DOMENICI. Before I leave, let me ask you one question, speaking, Dr. Brewer, of competition with our own domestic enrichment program, Senator McClure has talked about one aspect, brought out one aspect of policy. I want to ask you if it would really make sense for the United States to make available the best technology we have in gas centrifuge technology to foreign countries? Will that not be placed in direct competition with what you are here testifying we ought to proceed with?

And I know before you answer this that your answer will be if we don't somebody else will. I am not sure of that with reference to this particular gas centrifuge technology. But I do understand it is

the policy of this administration to make it available to foreign countries. Is that right?

Dr. BREWER. It is not quite as simple as that, Senator. You did answer the way I would have answered it. They are going to do it anyway. It is better that they be our partners than Urenco's partner or Eurodif's.

Senator DOMENICI. Is it policy now in the administration to make available gas centrifuge technology to foreign countries, particularly Australia, for example?

Dr. BREWER. No, sir, it is not our policy to do so. We are examining that particular case very intensively but it is not our policy to at this time, to make our technology, particularly our advanced technology available to a foreign country without massive guarantees.

Senator DOMENICI. I hope you continue to intensely study it. I wish that to take a long, long time, perhaps years.

I am going to yield now to the distinguished Chairman.

Senator FORD. I have one more question, Mr. Chairman, if I may. Dr. Brewer, is it likely that centrifuge capacity beyond GCEP would be built at Oak Ridge and Paducah due to the facts that you already own the sites, the local communities are accustomed to and supportive of the existing operation and the plants for making the uranium hexachloride gas are already close by?

Dr. BREWER. Senator Ford, as a practical matter, I do believe that if there is a centrifuge expansion beyond the 13 million separative work units of GCEP that it would be on an existing Federal enrichment site for the reasons you have cited. The population is accustomed to the operation. Uranium hexafluoride facilities are there, transportation facilities are there and, further, I believe that a dispersal of centrifuge capacity or new enrichment capacities are in order too.

Senator FORD. Thank you, Mr. Chairman.

The CHAIRMAN [presiding]. Thank you very much, Mr. Secretary. I appreciate your testimony today and I appreciate the fact that while I raise questions about policy you do not have total governmental policy within your grasp.

Dr. BREWER. Not yet, Mr. Chairman.

The CHAIRMAN. I am quite confident if you did, there would be some changes in that policy. And I appreciate your testimony here today and your steadfast and sometimes courageous approach for things we have been trying to do.

Dr. BREWER. Thank you, Senator.

[The following correspondence is submitted for the record:]

11-564 O—82——6

JAMES A. MC CLURE, IDAHO, CHAIRMAN
MARK O. HATFIELD, OREG.
LOWELL P. WEICKER, JR., CONN.
PETE V. DOMENICI, N. MEX.
MALCOLM WALLOP, WYO.
JOHN W. WARNER, VA.
GORDON J. HUMPHREY, N.H.
FRANK H. MURKOWSKI, ALASKA
DON NICKLES, OKLA.
JOHN F. EAST, N.C.
JAKE GARN, UTAH
HENRY M. JACKSON, WASH.
J. BENNETT JOHNSTON, LA.
DALE BUMPERS, ARK.
WENDELL H. FORD, KY.
HOWARD M. METZENBAUM, OHIO
SPARK M. MATSUNAGA, HAWAII
JOHN MELCHER, MONT.
PAUL E. TSONGAS, MASS.
BILL BRADLEY, N.J.
MICHAEL D. HATHAWAY, STAFF DIRECTOR
CHARLES A. TRABAUDT, CHIEF COUNSEL
G. MICHAEL HARVEY, CHIEF COUNSEL FOR THE MINORITY

United States Senate
COMMITTEE ON
ENERGY AND NATURAL RESOURCES
WASHINGTON, D.C. 20510

October 19, 1982

The Honorable Shelby T. Brewer
Assistant Secretary for Nuclear Energy
The Department of Energy
Weshington, D.C. 20585

Dear Dr. Brewer:

We are attempting to close our records of the hearing of the Subcommittee on Energy Research and Development that was held on June 24, 1982, Oversight Hearings on the Department of Energy's Uranium Enrichment Program. In that regard, we are asking that you provide the Subcommittee with a copy of the Department of Energy's response to the attached White House Memorandum relating to uranium enrichment.

We very much appreciated your appearance before the Subcommittee and look forward to your response to this request. Thank you for your cooperation.

Sincerely,

Pete V. Domenici
Chairman, Subcommittee on
Energy Research and Development

PVD/pgh
Enclosure

THE WHITE HOUSE

WASHINGTON

7 July 1982

MEMORANDUM FOR THE SECRETARY OF ENERGY

In response to your 5 May 1982 memorandum to the President on uranium enrichment, it is requested that DOE, in conjunction with OSTP and OMB, prepare the following analyses:

(1) Proceed with the consultations with industry you recommended and complete the options paper on possible transfer of the U.S. uranium enrichment business to the private sector.

(2) As part of our private sector transfer effort and in view of current Congressional funding problems, please prepare an analysis of whether ongoing construction of the Gas Centrifuge Enrichment Plant (GCEP) be continued, delayed or terminated. The analysis should include consideration of incentives for getting the private sector to complete construction of GCEP.

(3) As a possible aid to our domestic uranium industry, in recognition of the decreasing price of raw uranium and the increasing power costs for enrichment, provide an analysis of whether the current enrichment plant operating parameters should be changed to increase uranium throughput. This should include consideration of halting the sell-off of our existing stockpile of enriched uranium.

These actions should be completed as soon as possible so that these issues may be considered by the Cabinet Council on Natural Resources and the Environment early in August.

Thank you.

FOR THE PRESIDENT:

Edwin Meese III

EDWIN MEESE III
Counsellor to the President

Department of Energy
Washington, D.C. 20585

November 4, 1982

Honorable Pete V. Domenici
Chairman, Subcommittee on Energy
Research and Development
Committee on Energy and Natural Resources
United States Senate
Washington, D.C. 20510

Dear Mr. Chairman:

Enclosed is a memorandum from Secretary Edwards to Edwin Meese III, dated August 3, 1982, in response to your letter of October 19, 1982 requesting additional information relating to the June 24, 1982, hearing on uranium enrichment.

If you have any questions, please call Diana Diamond or Tom Pretorius of my staff on 252-4277. They will be happy to assist you.

Sincerely,

for Thomas H. Pretorius

Robert G. Rabben
Assistant General Counsel
for Legislation

Enclosure

cc: Mr. Paul Gilman
Staff Director
Subcommittee on Energy
Research and Development

THE SECRETARY OF ENERGY
WASHINGTON, D.C. 20585

AUG 0 3 1982

MEMORANDUM FOR Honorable Edwin Meese III
Counsellor to the President
The White House

With reference to your memorandum of July 7, 1982, on uranium enrichment, the Department has completed a series of informal consultations with industry regarding methods through which private entry into the enrichment business could be achieved. Industry representatives advise that significant improvements in current market and economic conditions must be achieved before privatization of the enrichment enterprise can occur. The conditions which must be remedied include: long-term demands for separative work must be increased through the deployment of additional light water reactors; venture capital must be available at reduced interest rates; and protection against predatory competition from non-U.S. suppliers must be provided. As an example of the industry's perspective on this issue, enclosed are the conclusions reached by the Chairman of the Board of the Goodyear Tire and Rubber Company.

Based on these consultations, I believe that private entry into the enrichment business should be pursued as a long-term policy objective, with near-term emphasis placed on creating the market climate in which privatization can occur. Licensing reform, establishment of effective waste management and reprocessing systems, and expeditious completion of the Gas Centrifuge Enrichment Plant (GCEP) will produce powerful incentives for commercial enrichment ventures. Revitalization of the nuclear option is the necessary first step to ultimate achievement of enrichment privatization.

The requested analyses of the GCEP schedule and the current enrichment plant operating parameters have already been prepared by the Department. These studies were carefully considered by the Department and the Office of Management and Budget during formulation of the FY 1983 Congressional budget and associated testimony. Numerous construction schedules were thoroughly evaluated. In all cases, continued construction, in fact, acceleration of the construction of GCEP yields superior benefits both to the the Government and the customer; the Department continues to strongly support completion of the project for both economic and market reasons. It should also be noted that all costs of the enrichment enterprise, including the cost of GCEP are offset in FY 1983 by the receipt of revenues obtained through the sales of enrichment services. With respect to private sector completion of GCEP, the only serious scenario posed to the Department would have ultimately involved multi-billion dollars in Government loan guarantees for debt servicing associated with the project.

Increasing the level of uranium throughput, by altering the tails assay at the existing enrichment plants, has also been evaluated. Increasing from the current 0.20 percent U-235 tails assay level to 0.25 percent U-235 increases natural uranium consumption by only 9 percent. If the Department were to exceed the 0.25 percent U-235 level, about 72 percent of our customers could terminate their enrichment contracts free of charge. Thus, increasing throughputs to the maximum allowable limit would be of negligible assistance to the mining and milling industry. Increasing the tails assay does reduce the amount of separative work needed by the customer. However, because most of the costs of enrichment plant production are fixed, separative work prices would increase by about $10 per unit at the higher tails assay level. This increase would offset any savings realized by the customer. It is our policy to minimize our costs and those of our customers. From our analysis, we have concluded that increasing the tails assay is not cost beneficial to either us or our customers.

Our analyses also have shown that it is cost beneficial to dispose of our excess enriched uranium stockpile as quickly as reasonably possible. Enriched uranium has two components, a separative work component and a natural uranium component. In its transactions with customers, the Department only sells enrichment services (i.e., separative work). The customer must provide all of the natural uranium needed for his product to the Department. Thus, as the Department's enriched uranium inventory is depleted, its natural uranium inventory increases. As a result, the Department in no way competes with the natural uranium producers by reducing its stockpile. A summary of the Department's analyses is enclosed for your information.

I believe it is through continued pursuit of the President's nuclear power policies that a marketplace solution to the enrichment issue can be found. I will keep you apprised of any further developments in this matter.

Jim Edwards

James B. Edwards

2 Enclosures

CONCLUSIONS

PROVIDING URANIUM ENRICHMENT SERVICES DOES NOT APPEAR TO BE A VIABLE BUSINESS OPPORTUNITY FOR PRIVATE INDUSTRY.

- MARKET IS NARROW AND VARIABLE; SUBJECT TO UNCERTAINTIES OF U.S. POLITICS.
- INVESTMENT IS EXCESSIVE IN COMPARISON TO POTENTIAL REVENUES.
- SIGNIFICANT CONGRESSIONAL ACTIONS ARE REQUIRED TO MAKE COMMERCIAL FEASIBILITY POSSIBLE.
- DEFENSE REQUIREMENTS WILL NECESSITATE GOVERNMENT PRIORITY ON OPERATING PLANS.
- U.S. PRIVATE ENTERPRISE CANNOT COMPETE WITH FOREIGN NATIONALIZED SUPPLIERS, WHO MAY SET PRICES ON OTHER THAN A PROFIT BASIS.

CONCLUSIONS REGARDING PRIVATIZATION OF URANIUM ENRICHMENT SERVICES

Many factors peculiar to the production and marketing of uranium enrichment services (UES) combine to make UES a non-viable opportunity for private industry.

The market is narrow and variable, having one product with a limited number of customers and major uncertainties in demand. In addition, national security and nuclear non-proliferation objectives make the industry subject to the vagaries of U.S. politics.

The investment in plant, equipment, and inventory is excessive in relation to the sales potential. The annual turnover of this investment is considerably less than for U.S. manufacturing industries, as shown on Page 27. It is highly unlikely, therefore, that private industry could realize a satisfactory return on investment.

In order for UES to be considered as a potentially feasible opportunity for private industry, Congress must pass specific enabling legislation. This legislation would have to provide government guarantees and safeguards against market conditions peculiar to UES. In some respects, industry would have to be treated as a national utility. Congress was unwilling to pass similar legislation in 1976, and there is little assurance Congress would be willing to pass such legislation now or in the near future.

Assuming the privately operated UES would be required to serve national defense, the government must, of necessity, retain the right to set operating priorities, even in peace time. This would occasionally interfere with industry's objectives.

U.S. private enterprise is at a distinct disadvantage in competing with existing foreign nationalized enrichment industries that set pricing and marketing objectives on other than a profit basis. Since the foreign market is projected at approximately 70 percent of the world market, this is a significant obstacle for private industry.

In summary, privatization of UES was unsuccessful in 1976 after considerable study, evaluation, and negotiation between industry, ERDA, and government. Privatization is even less feasible today in view of the depressed market, nationalized foreign competition, high interest rates, scarcity of capital funds, and the potential advent of new enrichment technology and the breeder reactor.

Enclosure

Summary of the FY 1983 Uranium Enrichment Operating Plan

Introduction

Each year the Department of Energy (DOE) prepares a long-range uranium enrichment operating plan. The current plan was determined based on evaluation of a large number of alternatives for meeting forecasted demand. The method used was to develop 20-year plans to meet demand using different mixes of gaseous diffusion plant (GDP) production and gas centrifuge enrichment plant (GCEP) production. These plans were prepared using different inventory target levels and tails assay assumptions. Each plan was then evaluated on the basis of economic and other criteria.

The primary objectives of this analysis were (1) to reexamine the validity of the overall long-range enrichment strategy; (2) to update the DOE enrichment operating plan from the period FY 1982 to FY 1995; and (3) provide the basis for FY 1983 budget decisions and updating the price of enrichment services.

Methodology

Two computer models were utilized in the analysis: the uranium enrichment production planning model and the financial analysis model. The production planning model determines annual separative work requirements and annual inventories of enriched and natural uranium. These results feed into the financial model which is used to determine the discounted and undiscounted long-range economics of each alternative operating plan.

The specific issues examined included the demand for enrichment services, the appropriate near-term and long-term gaseous diffusion plant power levels, the proper level of low enriched inventory, the appropriate pace for construction of the GCEP, and the transaction tails assay level. Different mixes of electrical power usage, various GCEP availability schedules, alternative inventory management schemes, and different tails assays were considered. In addition, sensitivity cases for lower power cost, lower demand, introduction of advanced isotope separation technology (AIS), and lower feed costs were evaluated. A detailed financial analysis, typical of analyses done by large industrial firms, was performed on each of the alternative plans, including cash flow analysis and use of the time value of money concept (discounting). Each plan was then evaluated on the basis of economic and other criteria, including its impact on separative work prices, total costs to the Government and its customers, energy efficiency and technical achievability.

Assumptions and Options

The following assumptions and options were considered:

- Demand

  The nuclear power industry demand for enrichment services was based on the August 1981 Office of Uranium Enrichment and Assessment (OUEA) forecast of nuclear power growth to be serviced by DOE which is shown in the following table. The mid-range estimate was used in the base operating plans with the low estimate used for determining the sensitivity of long-range economics to demand.

Installed Nuclear Electric Generating Capacity

Serviced by DOE

(Net Gigawatts Electric)

	U.S.			Non-U.S.			Total		
	Low	Mid	High	Low	Mid	High	Low	Mid	High
1980	50	50	50	34	34	34	84	84	84
1985	80	90	99	44	47	52	124	137	151
1990	117	122	126	55	60	70	172	182	196
1995	130	140	150	67	86	104	197	226	254
2000	148	170	195	83	96	120	231	266	315

In addition, the demand model was adjusted to include enrichment services required for national defense purposes as provided to the Assistant Secretary for Nuclear Energy by the Assistant Secretary for Defense Programs.

- Operating Power Levels

  Alternative near-term and long-term gaseous diffusion plant operating power levels were considered. These included:

  - Operating at contracted power levels
  - Operating at less than contracted power levels

- Low enriched uranium inventory levels

  Various levels of low enriched uranium inventory level were considered. These included:

  - Inventories equal to 90 days of the following years demand
  - Inventories equal to 9 million separative work units (SWU)
  - Inventories equal to 9 million SWU's plus a 5 million SWU reserve for international fuel assurance purposes

- The pace of GCEP construction

  Various GCEP construction schedules were considered, including:

  - Maintain the current construction schedule
  - The impact of an accelerated construction schedule
  - The impacts of various delay schedules

- Transaction tails assay

  Two transaction tails assay modes were considered:

  - 0.20 percent U-235 which is the current mode
  - 0.25 percent U-235 beginning in FY 1984

Evaluation

Each plan was then evaluated on the basis of economic and other criteria. The economic criteria used were:

- Average SWU price
- Total enterprise cost
- Total customer cost
- Gaseous diffusion plant cumulative power usage

Other non-economic evaluation criteria include:

- Energy efficiency
- Flexibility to respond to future changes in demand
- Technical achievability
- Near-term budget impacts

Sensitivity Analysis

Selective cases in the previous analysis were rerun to determine their sensitivity to various deviations in the operating and economic assumptions. The sensitivity cases considered included:

- Lower than estimated power cost escalation
- Lower demand estimate
- The assumption that advanced isotope separation technology is developed successfully, in accordance with current cost estimates and is available in the mid 1990's
- Lower than estimated uranium feed costs

Results

Evaluation of the various cases led to the following conclusions for long-term operating strategy

- Power reductions in the near term are economic on a long-term basis even though capacity charges may have to be paid for power not utilized. Preproducing and carrying a large enriched uranium inventory for a long period of time is not economical. Production of 16.7 million SWU's/year during FY 1984-1986 permits all improved cells to be operational, and allows operation at constant power levels which results in more efficient power utilization and better economics.

- Long-term inventory levels should be reduced to the extent practical from an economic point of view. In all situations, economics are improved by maintaining the low enriched uranium inventory as low as practical. Elimination of the 5 million SWU reserve for international fuel assurance purposes reduces the price of enrichment services by $1-2 per SWU in the long term.

- It is desirable in all respects to build GCEP as rapidly as possible. GCEP results in lower long-term prices of $13-20 per SWU (in FY 1983 dollars), reduces total campaign costs by $9-12 billion, and reduces

discounted costs by $0.9 to $1.5 billion. Construction of GCEP remains economically competitive even if advanced isotope separation technologies are successfully developed and available in the mid-1990's. Because the technical achievability and schedule of AIS is still highly uncertain, GCEP provides greater assurance that sales commitments will be met. The results also supported building GCEP on as rapid a schedule as feasible. Delays in building GCEP will result in higher costs. For example, a 1-year delay results in higher costs over the campaign on the order of $0.8 to $1.0 billion (about $0.4 billion discounted).

- AIS technology development should continue to be pursued because of potential long-term benefits as a replacement for existing gaseous diffusion plant capacity or for new capacity.

- The current 0.20 percent U-235 transaction tails assay should not be changed in the near future. An early increase in transaction tails assay results in a need to increase the current price by about $10 per SWU. Maintaining the current 0.20 percent level also provides a major source of flexibility to meet unexpected demand increases or production losses.

The CHAIRMAN. Next we will hear from a panel. Mr. Richard L. Grant, president and chief executive officer, Boeing Engineering & Construction Southeast, Inc.; Charles Rowan, director of enrichment systems, Garrett/AiResearch Manufacturing Co.; Dr. E. O. Hartig, vice president, Goodyear Aerospace Corp.

We have your prepared statement which will be made a part of the record in full.

STATEMENT OF RICHARD L. GRANT, PRESIDENT, BOEING ENGINEERING & CONSTRUCTION SOUTHEAST, INC.

Mr. GRANT. Thank you, Mr. Chairman. In my style it is very likely that it will not be verbatim. I am Richard Grant. I am president of Boeing Engineering & Construction Southeast, Inc., which is a wholly owned subsidiary of the Boeing Co.

I appreciate very much this opportunity to present a private sector view. I think you will be perhaps somewhat surprised at how the private sector view of this program does evolve in the process of my statement. Let me start with a brief synopsis of how Boeing has entered this particular program, what our roles in general in the nuclear area are.

I will also address in a slightly different way than DOE, I think, some of the concerns of the GAO and the CRS group. We were not consulted by either of those two groups in the process of preparation of those reports and my comments, I think, will reflect how I would have responded to questions, had they been asked.

First of all, our role in uranium enrichment program is devoted solely to the manufacture of centrifuge machines at this time, also the development of the advanced gas centrifuges, which we are accomplishing in Oak Ridge and we are an access permit holder and study the classified technology associated with the advanced isotope separation technology processes.

The Boeing Co. and under my purview over the last few years have been involved in almost the entire nuclear fuel cycle with the exception of mining, milling and conversion. We are involved in nuclear powerplant construction. We were the contractor for the casts and transporter, both wet and dry, fuel storage facilities for the now defunct Exxon reprocessing plant to be located in Oak Ridge, Tenn.

We also built plutonium handling facilities in Los Alamos and a good many other things along those lines. We have no other, however, in the case of enrichment, either corporate or subsidiary involvement, with enrichment other than as a private sector supplier at this time.

We do, however, of course, have a very sizeable commitment to that in terms of dollars and people. We have conducted throughout the years continual analyses, economic analysis and technical analysis to verify in our minds what should be done as the next process step.

In doing that, we have made decisions and made commitments related to GCEP on the basis of that analysis which said that GCEP is technically sound, that Boeing's capabilities can be used beneficially to support that project, that Boeing's resources can be

invested at a profit and that there were clear economic and conservation benefits to the Nation.

As I mentioned earlier, we started examining this in 1974 from a private sector standpoint. As you will recall there was an enterprise underway at that time to put enrichment into the private sector. We were a part to two of the four basic or five, I guess it was, enterprises that we were examining at that time.

That activity, of course, changed with the defeat of the Nuclear Fuel Assurance Act when it was determined that it would not go into the private sector. Since that time we have continued to analyze the process and the economics and on an annual basis I publish to staff people here in the Congress and to various other agencies of the Government and private sector people that reevaluation of the economics and technologies.

The basis of that and those reexaminations, we made the necessary decisions and acted upon those analyses to do a number of things. First of all, we invested $10 million in Seattle to get ourselves in the position to develop the manufacturing capability for centrifuges.

In 1978, we started a site search for a factory location where we could support manufacturing rates required for the GCEP project. That is build a number of machines at the rate they were required in order to provision a GCEP project as planned.

In 1979, in September in fact, ground was broken in Oak Ridge, Tenn., for that factory. That factory today is in operation in its phase I size on that site. More than 300 people are at work in it producing the machines that are installed or being installed in the centrifuge plant demonstration facility in Oak Ridge and producing the components that will be delivered to Portsmouth, Ohio.

A little over $60 million of Boeing money, no one else's, not the Government's but Boeing's money, went into that facility. That is building the facility and equipping it with the tools. The situation today is that more than 600 vendors are at work in 30 States supplying the hardware, materials, and other things that we use in that factory.

About a half-mile from my main factory, we have a smaller R&D kind of facility where the test activities and development activities for the advanced gas centrifuge are underway. In that facility we have smaller scale centrifuge machines running uranium hexachloride and full-size machines positions are just now coming online to run these advanced concepts and tests of other ideas that people are working on.

This facility and my main facility as well are doing engineering design and test for producibility so that we can lower the cost of the components on the baseline machine as well as the advanced machine. The technology, its cost effectiveness, which attracted us to this program in the mid-1970's is at least as good today and somewhat better in my mind than it was at that time.

To illustrate some of the facts, there are six that I think are very important and ones that we certainly consider very carefully. The existing P1C model machine as it exists today works as planned. Its output is equal to or better than the projections that were made for it.

Its reliability and operation will be acceptable and it is getting better and we are making it better as are the other two companies represented at this table.

Second, 100 metric tons of enriched uranium has been produced with the centrifuge.

Third, the factor of 20 that we throw around so blithely on energy efficiency is not speculative. It is, in fact, demonstrated.

Fourth, value engineering programs in process in my facility and others are making the machine components more producible, at lower cost and with life cycle savings in the tens and hundreds of millions of dollars.

Fifth, after total expenditures, which are just now crossing the billion-dollar line the GCEP costs have remained on or below plan and have been that way since the start of the program. They are currently about $10 million under the plan line. That is a rare feature for programs like this.

Sixth, and last in that sequence, the technical advancements for increasing the individual machine and total enrichment plant output are well understood. We don't require any great technological breakthroughs to go to the so-called set forth five or six machines. They are logical extensions of the existing technology. It is much like taking a 727-100 model in its early days and becoming the 727-200 and 727-300.

Overall the gas centrifuge plant makes unprecedented improvements in energy efficiency, well beyond those possible in other process industries. It was not mentioned here today, but I think it is important to understand that when those plants, the diffusion plants, that is, are running full open, they are capable of considerably more electricity each year than the entire aluminum industry in this country.

The centrifuge offers an opportunity to take one of the world's most energy intensive industries and effectively decouple it both from supply and cost.

Let me proceed now to the discussion of the CRS and GAO issues as we see them. First of all, the demand issue. The present gas diffusion plant can supply a maximum of 27.6 million separative work units annually. If the total demands were never to exceed this amount, it is clearly possible to continue with this process, simply ignore the costs, ignore the market share, which I also believe would be lost, ignore the needless expenditure of a lot of electricity, hundreds of billions of kilowatt-hours and go about your business.

In any business, I suppose it is possible, however imprudent, to ignore these market factors, simply assume that your customers will always be willing to buy your product, whatever you have it priced at, and that the resources needed to conduct that business will always be available.

It might be observed if the demand were 27.6 million the appropriation necessary to buy electricity for the diffusion plant 63 billion kilowatt-hours of electricity would be $2 billion. On the other hand if that same demand existed and it were being supplied by centrifuge the billion would be $100 million.

All of the demand projections which I've seen in anybody's books including the Advanced Gas Centrifuge capability dictated production capability at least as large as the planned capacity centrifuge

including all of the advanced versions thereof up to 100 percent improved machine.

Therefore, it is not necessary to couple or consider demand as the sole criteria or as the important criteria in the importance of GCEP, so long as the total demand or even the U.S. demand alone equals or exceeds the capacity of GCEP. The economics and energy efficiency will favor GCEP.

The cost of electricity has been discussed. The cost of electricity which DOE has paid, as you were told this morning, has escalated since 1973. It is actually a little over 9 years now that it has escalated at 20 percent per year. That is clearly 8 or more percent, 10 percent as DOE has suggested, over the inflation in that time period.

It is difficult for me to perceive the factors that work in our economy and in the utilities' fiscal environment that are likely to significantly reduce or to eliminate its tendency to escalate faster than inflation.

In order for that to happen, one would have to figure out how to free the utilities from the cost of money, how to not couple their costs to the supply costs of oil, coal, and gas, and you would have to presume that in the long haul somehow or other it will never be required that construction and process be allowed into the rate structure.

Planning the future with a bet that these reduced cost factors will prevail is risky indeed. The difference in the cost of electricity for a centrifuge plant of 8.8 million SWU capacity is currently planned for GCEP and a like capacity of gaseous diffusion is $15 billion over a 25-year life if not 1 percentage point of inflation or electricity escalation occurs.

If on the other hand no inflation occurred but electricity escalated at 4 percent per year, which by the way is my personal estimate of what we will see between now and the end of the century on the average, then the difference would be $40 billion, no inflation, just electricity.

If instead it escalated at 8 percent the difference is over $100 billion. It is reasonable to assume that both the cost of electricity will escalate and inflation will occur. These factors will then impact the cost of electricity as well as other operating costs. If we could have a centrifuge plant online in 1990 in the configuration currently planned with the set three machines and the $8.8 million SWU capacity and the if inflation averaged 8 percent and if electricity averaged 4 percent over inflation as I have predicted, then the 25-year life cycle savings over gaseous diffusion would be $220 billion.

If instead we can bring the set four machine on, that is the 50-percent improved machine, in that same time period the cost savings under those same conditions will be $320 billion. If we can bring the set five and set six machines on at 100-percent improvement, it is $400 plus billion.

Preproduction issue is one of interest to me. It has been argued that increasing the power level of the existing gaseous diffusion plants and producing in the inventory would permit delay of a decision to bring the new capacity online. I am sure it would.

It is possible only though in a prudent way if the costs and risks are acceptable. The cost of such a decision of power cost alone be-

tween now and 1995 will be between $5 and $12 billion, depending on what happens to the price of electricity, $5 billion if nothing happens to it, $12 billion if it inflates to 4 percent.

In addition, the cost of adding the new capacity later will have suffered the same economic environment over that time period as did the electric utiliities. Therefore that delayed decision can add billions to the capital cost in that time. The central point, of course, is whether or not, you are willing to accept the cost and risk of waiting for potential new technology, which may require less capital.

It is not more energy efficient than the cost of centrifuge but may require less capital. Cost of waiting can be enormous. The risks are that the new technology may not be successful. Its cost can be equal to the centrifuge or greater and, of course, more importantly perhaps maybe the time it will take to develop it is longer than we can wait.

There will always be a new technology along just over the horizon. Waiting for it while spending unnecessary dollars and natural resources does not appear, in my view, to be a responsible plan.

A key consideration here, however, is the use of electricity. It might be reasonable to mine an inventory uranium to be enriched later with the energy efficient process. I can develop a scenario that says that might be an appropriate thing to do.

However, the needless expenditure of electricity when the means to conserve it are proven and under construction is another matter. Conservation is an issue that we need to pay a little more attention to.

I think our Nation's utilities are certainly vigorous in promoting energy efficiency in their customers. The citizens and industries of this country are spending billions of dollars to improve their energy efficiency. Utilities are planning rate structures to penalize the inefficient. Government is spending money on buildings and other operations to make them more energy efficient.

Boeing has two new airplanes undergoing certification which are 30 percent more fuel efficient. The transportation industry as a whole is striving to better their resources on more energy efficient products. It is hard to believe that any private citizen or industry has not taken some action in this country and spent some money to conserve in the past few years.

It would, therefore, appear to me to be an imprudent plan and one we should be criticized for not to proceed with the proven process to gain a factor of 20 improvement—by the way, the improvement that on the average is being obtained by the rest of the industry is on the order of 1.3 rather than a factor of 20. It is particularly true where great economic benefits can be had as well.

Some comparisons, if comparable factors of efficiency can be gained in other sectors, such as the automobile business, we would be driving cars today that can get 600 miles to the gallon. If we could make these kind of gains in the Boeing Co.'s mainstream business, we would be flying airplanes that could circle the globe three times without refueling, unlikely.

Furthermore, the 20 billion killowatt-hours that just the 8.8 million SWU GCEP plant will save each year would cost the taxpay-

ers, the citizens $15 billion of their own money for heat pumps and other kinds of home improvements.

The next issue I would like to address is the one of balance of payments. Last year the U.S. trade deficit was in excess of $28 billion. The U.S. civil aviation business helped offset a larger deficit by nearly $10 billion. As the Nation's No. 1 manufacturing exporter Boeing is proud to have been a major portion of that.

Uranium enrichment on the other hand at about a billion dollars has been characterized as an unimportant contribution to trade deficit reduction. If every $1 billion contribution were individually treated as unimportant, the future of our balance of trade would be in great jeopardy indeed.

The future sales of enrichment services internationally are important. The market share can only be maintained by improvement in price, availability, and supply reliability. The GCEP program offers the mechanism to insure all of these. And it is my contention that successful completion of GCEP in the advanced gas centrifuge can make the purchase of enrichment services from other than the United States very unattractive.

Advance isotope separation, that issue, the atomic vapor laser isotope separation process has been selected from between the three completing processes to proceed to full scale engineering development phase. That phase is intended to provide answers to some very critical, technical issues.

It will also provide data which was expected to yield confidence in the laser cost around 1987 and the refurbishment cost after 1989. This is shown in the Energy Research Advisory Board report of May 4. These results at that time may in fact show that it is a very good and very cost effective process.

If so, the program could proceed to production scale in the mid to late 1990's. By that time GCEP will be online. Set four improved machines will be installed and the capacity of that plant will be 13.2 million SWU. Also by that time a much more accurate estimate of what the future demand is will be possible.

If the AVLIS system succeeds this plan, it will be possible to proceed to replace all remaining gaseous diffusion supply in concert with GCEP, the total demand both domestic and foreign. On the other hand if AVLIS does not prove technically cost effective or if we find that its development time is longer than we can stand, it will be necessary to make adjustments to the overall plan.

It will be important to make frequent reassessments during the AVLIS development process to determine how to proceed beyond GCEP. It is possible, for example, that electricity may be simply too expensive or too precious for other reasons to continue gaseous diffusion, in which case decisions will have to be made early on as to how to proceed in the next phase.

AVLIS has been characterized as an alternative to GCEP. It will only become an alternative to GCEP when its performance and cost are proven and compared to those of the centrifuge at that time in the environment of that time. At that time it may become an alternative to centrifuge for replacement of the increment of gaseous diffusion capacity, which demand dictates over and above GCEP.

Let me summarize by saying I am sure Mr. Voigt will attest that I have not always agreed with DOE plans over a good many years and have been very vocal in that regard, but I must say that I and my company believe that DOE has a good uranium enrichment program plan in place. It responsibly addresses the future.

It provides for minimizing costs with the current inventory of enrichment capacity. It provides a fiscally responsible hedge against future uncertainty of both the demand and the cost of production. It relies in a balanced way on the maturity of process technologies.

It offers promise of maintaining and improving the U.S. position in the world market. It minimizes the impact on the U.S. Treasury by balancing revenues and expenditures. In addition it can't help but apply the management that has gone into the GCEP program overall and where the situation has been kept under such a magnificent cost control.

Few, if any, plans are perfect. I have not seen one. Critique is always valuable. However, it is my view and our view, that the DOE plan well withstands all fundamental kinds of criticisms. Cost comparisons that are made by the DOE model in my view tend to clutter the results somewhat, because they try to fit within too large a structure.

It would be much more appropriate for those analyses to be made strictly on the basis of the centrifuge by itself, that portion of gas diffusion by itself and not involve the other extraneous use of tails, of inventory, of others. However, those issues are being separated now, but we could argue that they were not done soon enough perhaps and we could argue that the pace of the program should be accelerated.

But pragmatically, I think the program is now being viewed in the correct way and it is being done at a safe pace. There are bona fide questions and uncertainties as to how we proceed beyond GCEP. It is possible, as I said before, the electricity may simply become too expensive or too scarce to use.

AVLIS may prove so cheap that additional GCEP centrifuge capacity will not be needed beyond this current GCEP. GCEP, advanced gas centrifuge, AVLIS and demand may combine to eliminate the need for gaseous diffusion altogether. However, any of these scenarios that we have discussed prudently and responsibly include GCEP. Economics and conservation issues demand it.

I doubt that there is any confusion in anyone's mind about my enthusiasm for this program and I hope that my company's commitment in dollars and personnel to the program are evidence of the corporate enthusiasim and dedication.

I thank you very much.

[The prepared statement of Mr. Grant follows:]

Statement of

Richard L. Grant, President

BOEING ENGINEERING AND CONSTRUCTION SOUTHEAST, INC.

Before the Energy and Natural Resources Committee

Subcommittee on Energy Research and Development

United States Senate

June 24, 1982

Statement of
Richard L. Grant, President
BOEING ENGINEERING AND CONSTRUCTION SOUTHEAST, INC.
Before the Energy and Natural Resources Committee
Subcommittee on Energy Research and Development
United States Senate

June 24, 1982

Mr. Chairman, members of the Subcommittee, ladies and gentlemen; I am Richard L. Grant, President of Boeing Engineering and Construction Southeast, Inc., a wholly-owned subsidiary of The Boeing Company.

I thank you for the opportunity to present information and views on the Department of Energy's Uranium Enrichment Program.

Let me start with a brief synopsis of Boeing's role and history in the program and then address a number of issues which have received considerable attention. The Department of Energy has done a very competent, realistic job of assessing issues raised by the Government Accounting Office and the Congressional Research Service. I will add only a slightly different perspective.

BOEING's ROLE AND HISTORY

Boeing's role in the Department of Energy's Uranium Enrichment Program is devoted to the manufacture of centrifuge machines, the development of advanced gas centrifuges and we are an access permit holder for the Advanced Isotope Separation technology. Although we have roles in nearly every energy form, we have no other corporate or subsidiary role in uranium enrichment. We have, however, a very sizable corporate commitment of dollars and personnel in the Gas Centrifuge Program. This commitment was made because our analysis of the overall program indicated that GCEP was technically sound, that Boeing's capabilities could contribute to its success, that Boeing resources could be invested at a profit and that there were clear economic and conservation benefits to the nation.

Boeing's participation in uranium enrichment began in 1974 with examination of the potential for private-sector enrichment. This activity changed with the defeat of the Nuclear Fuel Assurance Act. Since that time we have continually analyzed, evaluated and assessed the technical and economic rationale for enrichment processes. We have subsequently made the necessary decisions and acted upon frequent re-examinations of these technical and economic factors. The result was the expenditure of $10 million to put early development and manufacturing capability for the centrifuge in place in Seattle. In 1978, a site search was initiated for a new factory location capable of supporting the manufacture of centrifuges at the rates required for the Portsmouth Gas Centrifuge Enrichment Plant. Ground was broken for this factory in September 1979 in Oak Ridge, Tennessee. The factory is now complete and in operation in its Phase I size. More than $60 million of Boeing money was spent in building and equipping it. More than 300 people are at work in this factory producing the components and assemblies being delivered to the Centrifuge Plant Demonstration Facility in Oak Ridge and being prepared for delivery to Portsmouth, Ohio. More than 600 vendors and suppliers are at work in 30 states supplying components and materials to our factory. About one-half mile from our factory we have a smaller engineering development and test facility where about 30 people are working on the Advanced Gas Centrifuge and where smaller scale centrifuges are running on uranium hexafluoride gas to test improved and advanced machine components. Full-sized machine positions are nearing completion for running these and other advanced concepts on uranium hexafluoride. Engineering design and test is also proceeding toward improved producibility of components to lower their cost.

The technology and cost effectiveness which attracted us to the program in the mid 70's looks as good today or better. To illustrate:

1) The existing P1C model of the centrifuge works as planned. Its output is equal to or better than projections. Its reliability in operation will be acceptable and will be improved to even higher levels.
2) One hundred metric tons of enriched uranium have been produced with the centrifuge.

3) The factor of 20 or more improvement in energy efficiency over the gaseous diffusion process is demonstrated.
4) Value engineering programs in process are making machine components more producible, at lower costs and with life cycle cost savings of tens to perhaps hundreds of millions of dollars.
5) After total expenditures of $1 billion the GCEP costs have remained on or below plan -- a rare feature for programs of this type and size.
6) Technical advancements for increasing the individual machine and total enrichment plant output are understood. No great technological or laboratory breakthroughs are required. The Advanced Gas Centrifuge will succeed and will make even greater cost benefits possible.

The Gas Centrifuge Enrichment Plant Project makes unprecedented improvements in energy efficiency well beyond those possible in other process industries. It can take one of the most energy intensive industries in the world and effectively decouple it from both the supply and cost of energy.

From a slightly different viewpoint than that of the Department of Energy's assessment of the concerns raised by the Government Accounting Office and the Congressional Research Services, I will address a few of the issues here today.

DEMAND ISSUE

The Government's present Gaseous Diffusion Enrichment capacity is ultimately capable of supplying a demand of 27.6 million Separative Work Units (SWU) of enriched uranium. If total demand were never to exceed this amount, it is clearly possible to continue with this process, simply ignore the costs incurred, ignore the market share which would be lost to competition and ignore the needless expenditure of hundreds of billions of kilowatt hours of electricity. In any business, I suppose it is possible (however imprudent) to ignore these market factors; simply assume that your customers will always be willing to buy your product at any cost and that the resource needed to conduct the business will always be available.

It is interesting to observe that if a 27.6 million SWU demand were being supplied by gaseous diffusion today, the appropriation necessary for electricity alone would be over $2 billion (1983 dollars) to pay for more than 63 billion killowatt hours of electricity. The electricity cost of the same quantity of enrichment by the centrifuge process would be less than $100 million.

All of the projections of demand which I have seen dictate a production capability at least as large as the planned capacity for GCEP including the Advanced Gas Centrifuge capability out through what is called Set VI (the 100% improved centrifuge). Therefore, it is not necessary to couple demand to the need for GCEP if it is appropriate to believe that the product needs to be supplied in a cost and energy efficient manner. So long as the total demand (or even the U.S. demand alone) equals or exceeds the capacity of GCEP, economics and energy efficiency both will favor GCEP.

COST OF ELECTRICITY ISSUE

The cost of electricity which the DOE has paid for its enrichment business has escalated, since the 1973 oil embargo, at an average of about 20% per year. This is, clearly, at least 8% per year over inflation. It is very difficult to perceive the factors at work in our economy or in the utilities fiscal environment which will cause these costs to cease escalation at rates which exceed inflation. In order to assure otherwise, one must determine how to free utilities from the cost of money and assume that the cost of coal, oil and gas will also not outstrip inflation.

Planning the future with a bet that these reduced cost factors will prevail is risky business indeed. The difference in the cost of electricity for a centrifuge plant of 8.8 million SWU capacity and a like capacity of gaseous diffusion is $15 billion over a 25-year life starting in 1983 even if no inflation or electricity cost escalation occurred. If no inflation occurred but electricity cost escalated at 4% per year, the difference would be $40 billion. If escalation occurred at 8%, it would be over $100 billion.

It is reasonable to assume that both electricity cost escalation and inflation will occur. These factors will then impact the cost of electricity as well as other operating costs. If we could have a centrifuge plant on line by 1990, inflation averaged 8% and electricity averaged 4% over inflation, the costs over a 25-year life would be over $220 billion less using the existing centrifuge machine than the cost for the same production using gaseous diffusion. The cost difference would exceed $320 billion if the Set IV improved centrifuge is used and $400 billion if the further advances of Set V and Set VI machines are employed. (See attached chart.)

PRE-PRODUCTION ISSUE

It has been argued that increasing the power level on the existing gaseous diffusion plants and producing into inventory would permit delay of a decision to bring new capacity on line. This approach is possible if the cost and risk are low. The cost of such a decision in power costs would be between five and twelve billion dollars through 1995 depending on the future economic conditions. In addition, the cost of adding new capacity later will have suffered the same economic environment and could increase the new capital costs by billions of dollars.

The central point to this issue is the cost and risk of waiting for a potential new technology which may require less capital. The cost of waiting can be enormous. The risk is that the new technology may not be successful or that its costs may be equal to or greater than the centrifuge or that its development time will exceed the ability to wait.

There will always be a new technology of the future. Waiting for it while spending unnecessary dollars and national resources does not appear to be a responsible plan. A key consideration here is the use of electric energy. It might be reasonable to mine and inventory uranium to be enriched later with energy-efficient processes. The needless expenditure of electric energy when the means to conserve it are proven and under construction is another matter.

CONSERVATION ISSUE

Our nation's utilities are vigorously pursuing and promoting energy efficient electricity utilization. Our citizens and industries are spending billions of dollars to improve the efficiency of their energy utilization. Utilities are planning rate structures to penalize inefficient use of electricity. Government buildings and other operations are being made more energy efficient.

Boeing has two new airplanes undergoing certification which are over 30% more fuel efficient. All of the transportation industry is striving for and betting their resources on more efficient products and operations. There are few, if any, industries or private citizens who have not taken some actions and spent some money to conserve. These very worthwhile efforts are underway to gain fractional improvements in efficiency. It would, therefore, appear an imprudent plan not to proceed with a proven process to gain a factor of 20 improvement in an enormously energy intensive industry, particularly where the improvement offers great economic benefits as well.

If comparable factors of efficiency could be gained in other sectors, we would be driving cars getting 600 miles per gallon, and flying commercial aircraft which could circle the earth nearly 3 times without refueling. To save nearly 20 billion kilowatt hours of electricity, private citizens would have to spend over $15 billion (1983 dollars) on heat pumps and such.

BALANCE OF PAYMENTS ISSUE

Last year, America's trade deficit was nearly $28 billion. United States civil aviation helped offset a much larger deficit by nearly $10 billion. As the nation's number one manufacturing exporter, Boeing is proud to have been the major portion of this. Uranium enrichment at about $1 billion has been characterized as an unimportant contribution to trade deficit reduction. If every $1 billion contribution were individually treated as unimportant, the future for the United States' balance of trades would be in great jeopardy.

The future sales of enrichment services internationally are important. The market share can only be maintained and improved by price, availability and supply reliability. The GCEP program offers a means to assure all of these factors for the DOE's Uranium Enrichment Program. Successful completion of GCEP and the Advanced Gas Centrifuge Program can make the purchase of enrichment services from other than the United States very unattractive.

ADVANCED ISOTOPE SEPARATION ISSUE

The Atomic Vapor Laser Isotope Separation (AVLIS) process has been selected to proceed with the full-scale engineering development phase. This phase will provide answers to several technical issues. It will also provide data which is expected to yield confidence in laser costs around 1987 and refurbishment costs some time after 1989, as shown in the May 4, 1982 Energy Research Advisory Board Report. These results may show that the process is a good, cost-effective one. If so, the program could proceed to production scale in the mid 90's.

By this time, the GCEP will be on-line and Set IV improved machines will have raised the capacity of GCEP to 13.2 million SWU annually. Also, by this time, much more accurate estimates of demand will be possible.

If AVLIS succeeds as planned, it will be possible to proceed to replace all remaining gaseous diffusion capacity to supply, in concert with GCEP, the total demand both domestic and foreign.

On the other hand, if AVLIS does not prove technically and cost effective or if we find its development time to be longer than planned, it will be necessary to make adjustment to the overall plan. It will be important to make frequent reassessments during the AVLIS development process to determine how to proceed beyond GCEP. It is possible, for example, that electricity may become too expensive or too precious to continue gaseous diffusion, in which case it will be necessary to either add more centrifuge capacity or proceed with AVLIS at an early date.

The AVLIS has been characterized as an alternative to GCEP. It will only become an alternative when its performance and cost are proven and compared with those of the centrifuge at that time, in the environment of that time. At that time, it may become an alternative to centrifuge for the replacement of the increment of gaseous diffusion capacity which demand dictates over and above GCEP.

SUMMARY AND CONCLUSIONS

In summary, we believe that the DOE has a good Uranium Enrichment Program Plan in place which responsibly addresses the future. It provides for minimizing costs with the current inventory of enrichment capacity. It provides a fiscally responsible hedge against future uncertainty of both demand and the cost of production. It relies in a balanced way on the maturity of the process technologies. It offers promise of maintaining and improving the U.S. position in the world market. It minimizes the impact on the U.S. Treasury by balancing revenues and expenditures. In addition the DOE has demonstrated an exceptional ability to plan, manage and control a very large high technology capital program in GCEP.

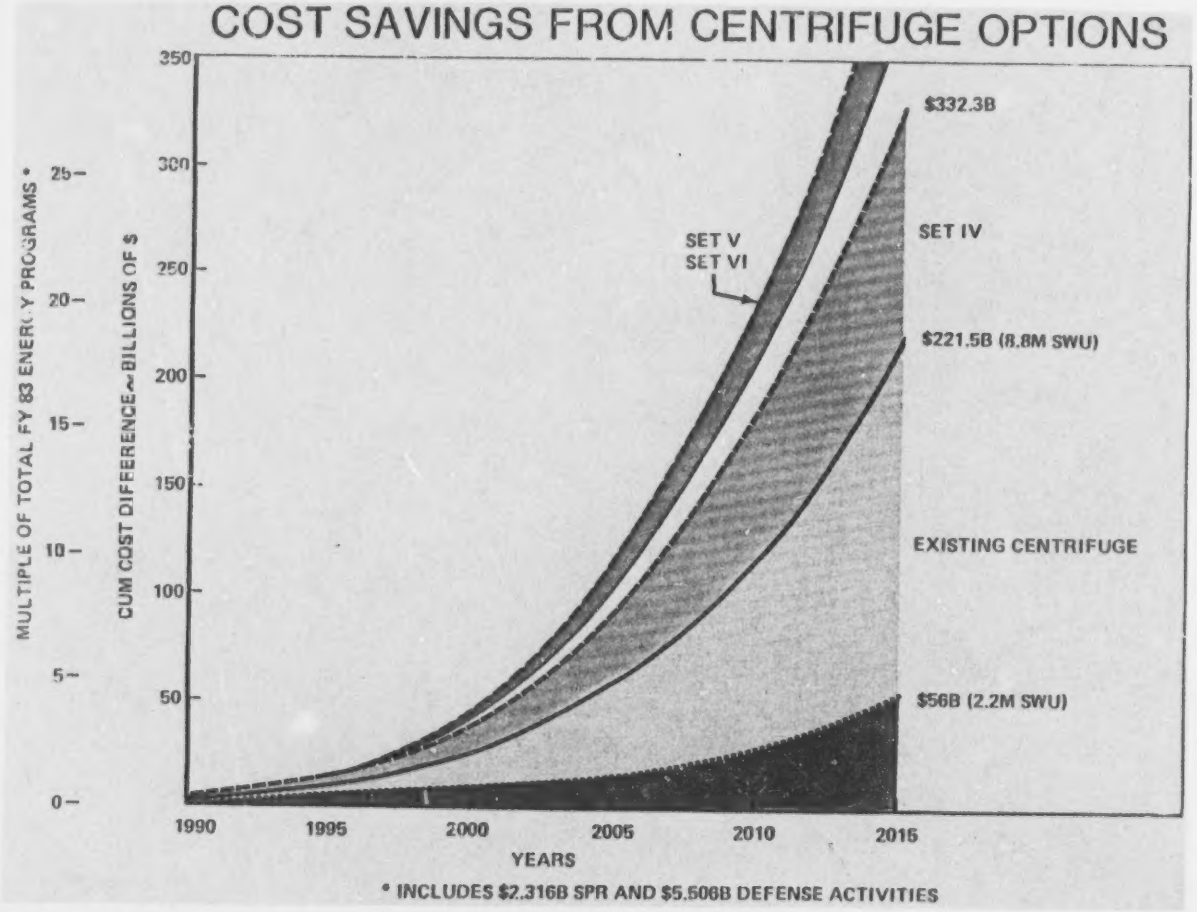
Few, if any, plans are perfect and review and critique is always valuable. However, the DOE plan, in our view, well withstands nearly all fundamental criticisms. It may be that the separation of the GCEP from other unrelated enrichment issues was not done soon enough and that the pace of the program should be accelerated, but programmatically it is now being viewed properly and at a safe pace.

There are bonafide questions and uncertainties as to how to proceed beyond GCEP. It is possible that electricity may become too expensive or too precious to continue with gaseous diffusion under any circumstances. AVLIS may prove so cheap that no additional centrifuge capacity beyond GCEP will be needed. GCEP, Advanced Gas Centrifuge, AVLIS and Demand may eliminate the need for gaseous diffusion altogether. However, any of these scenarios prudently and responsibly include GCEP. Economics and conservation issues demand it.

Finally, in a national and world environment of emphasis on conservation of energy; fuel efficient cars, airplanes, lights and motors; home improvements in insulation, heat pumps, water-heater blankets and so forth, I cannot help but fault a philosophy which promotes the needless consumption of hundreds of billions of kilowatt hours of electricity on the thesis that 10 or 15 years hence we may be able to do better, not in electricity consumption, but in cost. The shortsightedness which we fear the public has adopted with today's cost and supply of gasoline appears to have crept into some evaluations of the U.S. Enrichment Enterprise.

I think my enthusiasm for the program is clear. I would hope that Boeing's current commitments to the program are evidence of the corporate enthusiasm.

Thank you for your attention.


COST SAVINGS FROM CENTRIFUGE OPTIONS
MULTIPLE OF TOTAL FY 83 ENERGY PROGRAMS *
CUM COST DIFFERENCE – BILLIONS OF $
350
300
250
200
150
100
50
25
20
15
10
5
0
1990
1995
2000
2005
2010
2015
YEARS
$332.3B
SET V
SET VI
SET IV
$221.5B (8.8M SWU)
EXISTING CENTRIFUGE
$56B (2.2M SWU)
* INCLUDES $2.316B SPR AND $5.506B DEFENSE ACTIVITIES

Senator DOMENICI [presiding]. We will proceed with the next witness in the last panel before questions, unless there is a Senator who has a time problem and then he can ask questions as we proceed.

Mr. Charles Rowan, director, enrichment systems, Garrett/AiResearch Manufacturing Co., Torrance, Calif. Mr. Rowan.

STATEMENT OF CHARLES ROWAN, DIRECTOR, ENRICHMENT SYSTEMS, GARRETT/AIRESEARCH MANUFACTURING CO.

Mr. ROWAN. Thank you, Senator, and thank you very much for the opportunity for Garrett to present its views this morning to you.

I am Chuck Rowan, director of enrichment systems for the AiResearch Manufacturing Co., which is a division of the Garrett Corp. We are one of the signal companies in California.

AiResearch the company division for which I am their representative today has been a pioneer in gas centrifuge development. We have competed along with 19 other companies total in 1961 for development contract with then the governmental agency the Atomic Energy Commission. We were picked because, I believe, our company's experience is well established in the industry as a manufacturer, designer and builder of high-speed rotating equipment.

For example, we are on many of the airplanes that Dick Grant's parent company manufactures. We supply equipment of that type to missle systems that the Goodyear Co. manufactures and so on. The company's exceptional range and depth of experience as a high-speed rotating equipment designer provided unique qualifications for developing a machine of this nature.

The Garrett Corp. has built over half of all of the centrifuges that have ever been made in the United States. The company through its broad diversity and capabilities within its many product lines is uniquely structured also as an energy company. We are engaged in high technology research and development and have long been dedicated toward energy conservation as a fundamental approach to our aerospace product design.

A few of these applications, I might mention, include our heat transfer capabilities, which had ready application to the recovery of waste heat in industrial manufacturing and processing plants; for our manufacture of gas turbines in high propulsion engines for the general aviation market and these engines have offered very significant fuel economy to buyers.

Our propulsion units and braking systems for high speed rail transportation, for example the Atlanta system, together with flywheel storage systems, like those installed in the New York Metro, for tracked vehicles and buses, have made significant contributions to present and future economies in the surface transportation areas. Our GT-601 gas turbine engine for heavy-duty trucks offers important economies in the intercity transport of freight.

I mention all of these products not in any advertising way for Garrett, but to merely illustrate to you that the fundamental premise of all of our products takes into account energy conservation and high efficiency process and certainly the evolutionary design of the present-day centrifuge is very much in this design tradition.

As I mentioned Garrett was competitively selected as one of the original designers and manufacturers of centrifuge machines which have been installed and tested at Oak Ridge, Tenn., over the years. Garrett was a major contributor in bringing the centrifuge machine to its present state of production readiness for installation in the gas centrifuge plant at Portsmouth.

In order to fulfill the challenge of mass producing and testing gas centrifuge machines for installation in the GCEP, the Garrett Corp. has leased an inactive Government facility at Sandusky, Ohio and we have expended to date almost $18 million to modify the building to our specific requirements and substantive employment has occurred in this severely labor depressed area of Ohio.

One-hundred million dollars of additional Garrett Corp. investment will be required to construct the necessary expanded facilities suitable for the so-called phase II production contracts for GCEP based on an eight-building complex. It is anticipated that if we are fortunate enough to receive that award that about 1,500 to 2,000 new jobs will be created in the Sandusky area.

Over and above the Sandusky investment, the company has invested $15 million for capital, facilities, and equipment at Torrance in order to conduct their various tasks and perform them that DOE has assigned to us. This expenditure was required in order to support both development and the production phase of the program, which we feel must be continued to realize the ultimate potential of the centrifuge.

My whole purpose in mentioning the extent of our financial investments and the duration of our efforts since 1961, 21 years, is to establish the magnitude of the Garrett Corp. commitment and the depth of our dedication to this important national program. We would not be doing it if we did not think that it was a proper corporate objective to aspire to or to invest our capital in.

As a high technology company and in business for over 40 years, we are not unfamiliar with making significant financial commitments in the course of pursuing new business ventures. It is quite common. If a particular program requires continued commitment over an extended period of time, we constantly review the prevailing conditions. We compare them to our current business goals and we determine the feasibility of completion.

It is not an infrequent event in our business environment that conditions change over the course of a multiyear program. So it comes as no surprise to us that a recalibration of the GCEP viability is taking place in the current nuclear industry slowdown situation and the Government budget review climate.

However, the Department of Energy's enrichment function is truly unique and aspects of that uniqueness have certainly been touched upon this morning in the presentations and in the discussions held. It is unique in that it is vitally concerned with nuclear nonproliferation and classified technology considerations, but at the same time it attempts to and does increasingly model itself on a commercial enterprise.

It therefore maintains a marketing organization through DOE. It attempts to compete in an open worldwide market. It conducts its own R&D, as any good enterprise would do and it pays for its own operation and expansion through the revenues generated from en-

terprise efforts, which is rather extraordinary in itself, the way that is structured, that GCEP should have to be paid for out of current operating funds received from SWU.

We note very approvingly that DOE enrichment service management organization increasingly models its operation on industrial practices through the generation of annual reports, containing balance sheets and profit and loss statements, like we in industry have to do.

In 1979 the Government asked private industry to join them in their enterprise by establishing an industrial base for gas centrifuge production and manufacture. Industry duly assessed the business risks involved versus the potential for success and they responded very favorably. At Garrett, this decision involved expenditures of a very sizable amount of private capital and we are sure that the other GCEP selected equipment suppliers here at the table with me this morning have also made corresponding outlays.

With the stated considerations in mind, I would like to respectfully submit that the Members of Congress also play a vital role in protecting the viability of a multibillion-dollar Government controlled enterprise, which really ought to be used ultimately as a national energy asset. The decision on GCEP funding has very far-reaching implications and we feel it must be rooted in basic business principles that include a whole array of judgmental factors well beyond those that are enumerated in any cost model.

From Garrett's viewpoint, we think the Congress should include in its consideration the importance and the cogency of a number of factors, which I would like to enumerate.

First of all, the product protects DOE's core business in enrichment service by providing assured capacity at the lowest cost.

GCEP embodies all of the latest proven enrichment technology that is sufficiently developed for cost-effective production use.

Ultimately GCEP will provide a separative work cost base which will continue to permit competitive pricing in the domestic and international marketplace. The ability for the United States to compete aggressively and successfully in the world market is a significant element in providing a positive contribution to balance of payments position.

With the development of foreign enrichment competitors, the price of SWU, both near-term and over the life of the contract, has become a major factor in the sales effort of DOE with regard to potential foreign customers. Very great diligence and effort will have to be exercised to insure continuation of supply contracts even with domestic users. It is not just the foreign ones, but the domestic users. Price is going to govern.

In an overall enrichment enterprise that includes GCEP, we are quite sure that a positive cash flow can be maintained as long as GCEP is there. Without it, the cost increases for power actually experienced rather than postulated in a study may well create an even greater erosion of the U.S. share of the market.

GCEP has been paid for to date out of revenues, income coming in through the Government from SWU sales and it can continue to be fully financed by enrichment revenues if an aggressive attitude is reflected on a consistent basis by the Congress and the U.S. Gov-

ernment entities responsible for uranium enrichment services. A consistent, long-term policy is badly needed.

Perservation of SWU customer and plant equipment supplier relationships is a very significant factor in Garrett's mind, if the Government plans to continue the enrichment enterprise on a sound business basis. That is the way we look at all of our business. We look at the customer we are dealing with and we look at the supplier base that supports us in providing the product that we sell.

In the case of customers for SWU, they will react positively to actions that reaffirm the U.S. commitment to an adequate, reliable low-cost SWU supply. On the other hand, suppliers with large private investments at stake react adversely to any indication of a lack of long-term resolve.

Obviously, loss of the supplier base can only result in project failure, particularly for a project of this magnitude. In order to illustrate the potential ripple effect that major reduction in GCEP construction plans could cause, we would like to submit for the record a document summarizing the distribution of GCEP contracts to date, which is attachment I to this paper.

When you have an opportunity to peruse that it will be quickly seen that about 41 of the 50 States are affected.

The GCEP project encourages and reflects a very positive social and environmental consciousness through its ability to generate SWU while using only one-twentieth of the electricity required by the diffusion process. Even if somebody were to accept as valid that our future SWU requirements into the 1990's could be satisfied by the diffusion plants, it certainly would be appropriate in today's conservation-minded society to replace on a planned, near-term attrition basis the outdated diffusion capacity with the more energy-efficient centrifuge process, thereby freeing up many megawatts of already installed generating capacity for commercial and industrial exploitation.

As an aside, I would like to mention that nowhere in the GAO report, nowhere in the Congressional Research Services report or in any of the testimony I have heard or seen today has thought been given, for example, to the $4.5 billion worth of TVA plants that have been cancelled. Where is that $4.5 billion going to show up? Who is going to pay for that? Does it not have to flow through in rates to customers? And is not the primary customer in the TVA area some 20 industrial firms, 29, the premiere one of which is the enrichment plant itself, DOE.

Conversely, if the assumption is made that GCEP can be leapfrogged and we can depend on the diffusion plant capacity to provide SWU's or a preproduction arrangement on it, then indeed where is that power going to come from on the basis of the tenet and need for the DOE contract already covered in Dr. Brewer's testimony?

Are those plants going to be restored that have been cancelled, additional ones added? And if so at what expense and who pays for that bill?

I think the answer lies in greatly increased SWU cost, if GCEP is not continued in its construction process.

The Government's decision to proceed with GCEP was accompanied by commitments to the Department of Energy's customers,

plant equipment suppliers and to employees of the enrichment production facilities. These commitments were made by the government and they were accepted by industry in good faith.

In our business and in any reputable business, the business has the responsibility to fulfill their obligations. In this instance the U.S. Government is the primary controller of the enterprise.

GCEP has the technology at hand, the project is on schedule and well within the budget and nearly $1.5 billion of public money has been appropriated to date for its construction. And while an undesirable softening of the SWU market has occurred, it certainly has not disappeared altogether.

With only the orders on hand in DOE right now, a logical approach could be an authorization for construction of the full eight-building GCEP plant on the present or even an accelerated schedule, while simultaneously planning in an intelligent and controlled manner the turndown and phasing out of the diffusion plants under an early retirement plan.

A continuation of the present U.S. aggressive marketing effort should certainly be a part of any such enterprise.

At Garrett, we have read the GAO report and the Congressional Research Service study with great interest. They both draw conclusions based upon applied factors, projected costs and forecasted demand or lack thereof. They also use various other studies and published material to support their suppositions.

The Department of Energy has been obliged to reply to these stated opinions and respond in kind to data drawn from their own repertoire of information and resources. In some instances, both DOE and congressional committee staff services used the same data but drew different conclusions.

I think we would suggest that the prine considerations at this point in time on the future of GCEP should not be confined solely or exclusively to computer models interpretation, but that the business judgmental factors that we have noted above and in our testimony today ought to receive substantive consideration.

To summarize for you, GCEP protects the DOE's core enrichment service business. It utilizes cost-effective advanced technology. It is an assuror of a competitive SWU cost base and it permits continuing a positive cash flow of the U.S. enrichment enterprise and not have it price itself out of business.

It is a protection against future power cost increases and their severe impact on diffusion, operation and, therefore SWU cost. GCEP preserves very vital customer and supplier relationships that DOE has struggled hard to establish.

GCEP encourages a very positive social environmental consciousness through its energy-saving apporoach cooperation. It certainly honors the government's commitments and we hope it continues to. And its performance to date surely merits full plant construction continuation.

I think DOE has done an extraordinarily fine job of management. So many government activities are under fire in the press and elsewhere and it strikes us as purely extraordinary that such a well-managed program should be under attack and yet there it is after 4 years, on time, on budget, doing the performance job that it

offered in the beginning that it would do. It is an extraordinary accomplishment. They should be praised.

Mr. Chairman and members of the committee, Garrett Corp. comments today have obviously reflected more of a subjective view but no less real set of concerns than the seemingly more quantifiable kinds of material generated both by the legislative and executive branch organizations dealing with budget considerations.

However, in addition to economic modeling, the business principles we have tried to outline today in our comments have certainly served our company exceedingly well in the past on other projects to help decide important issues in an uncertain environment.

We hope that our sharing them with you today will be to our mutual benefit in the eventual unimpeded completion of GCEP.

And one final thought, I would like to ask you to reflect upon, it is paradoxical to our customary mode of commercial and industrial thinking and reacting that one of the most successful cash flow generators in the whole history of government-operated enterprises should now become unnecessarily constrained in a very proper effort to improve its worldwide competitive posture; exploit available, proven growth technology; assist in offsetting an undesirable balance of trade position and reduce the extraordinary energy consumption of the gaseous diffusion process.

Gentlemen, this concludes our comments today.

[The prepared statement of Mr. Rowan follows:]

STATEMENT OF CHARLES ROWAN

DIRECTOR OF ENRICHMENT SYSTEMS

AIRESEARCH MANUFACTURING COMPANY

BEFORE

SUBCOMMITTEE ON ENERGY RESEARCH AND DEVELOPMENT

COMMITTEE ON ENERGY AND NATURAL RESOURCES

U.S. SENATE

JUNE 24, 1982

I AM CHARLES ROWAN, DIRECTOR OF ENRICHMENT SYSTEMS FOR THE AIRESEARCH MANUFACTURING COMPANY, A DIVISION OF THE GARRETT CORPORATION, WHICH IS ONE OF THE SIGNAL COMPANIES. I AM ACCOMPANIED TODAY BY WILLIS SULLIVAN, MANAGER OF THE WASHINGTON, D.C. OFFICE OF THE GARRETT CORPORATION.

GAS CENTRIFUGE MACHINE DEVELOPMENT BEGAN AS A RESEARCH PROJECT AT THE GARRETT CORPORATION IN 1961. OUR COMPANY'S EXCEPTIONAL RANGE AND DEPTH OF EXPERIENCE AS A HIGH-SPEED ROTATING EQUIPMENT DESIGNER AND MANUFACTURER PROVIDED UNIQUE QUALIFICATIONS FOR DEVELOPING A MACHINE OF THIS NATURE.

THE GARRETT CORPORATION BY ITS BROAD DIVERSITY AND THE CAPABILITIES WITHIN ITS MANY PRODUCT LINES, IS UNIQUELY STRUCTURED AS AN ENERGY COMPANY. WE ARE ENGAGED IN HIGH TECHNOLOGY RESEARCH AND DEVELOPMENT AND HAVE LONG BEEN DEDICATED TOWARD ENERGY CONSERVATION AS A FUNDAMENTAL APPROACH TO AEROSPACE PRODUCT DESIGN. TO CITE A FEW OF THE APPLICATIONS IN WHICH OUR ACTIVITIES SHOW SUBSTANTIAL CONTRIBUTIONS TO ENERGY CONSERVATION WHICH, WE MIGHT ADD, REPRESENT A CORPORATE INVESTMENT OF OVER $100 MILLION IN RECENT YEARS - OUR HEAT TRANSFER CAPABILITIES HAD READY APPLICATION TO THE RECOVERY OF WASTE HEAT IN INDUSTRIAL MANUFACTURING AND PROCESSING PLANTS; OUR ADVANCED PRIME PROPULSION ENGINES FOR THE GENERAL AVIATION MARKET HAVE OFFERED SIGNIFICANT FUEL ECONOMIES; OUR PROPULSION UNITS AND BRAKING SYSTEMS FOR HIGH-SPEED RAIL TRANSPORTATION, TOGETHER WITH FLYWHEEL ENERGY STORAGE SYSTEMS FOR TRACKED VEHICLES AND BUSES, HAVE MADE SIGNIFICANT CONTRIBUTIONS TO PRESENT AND FUTURE ECONOMIES IN THE SURFACE TRANSPORTATION AREAS; AND OUR GT-601 GAS TURBINE ENGINE FOR HEAVY DUTY TRUCKS OFFERS IMPORTANT ECONOMIES IN THE INTER-CITY TRANSPORT OF FREIGHT. THE EVOLUTIONARY DESIGN OF THE PRESENT-DAY CENTRIFUGE IS VERY MUCH IN THIS DESIGN TRADITION.

GARRETT WAS COMPETITIVELY SELECTED AS ONE OF THE ORIGINAL DESIGNERS AND MANUFACTURERS OF CENTRIFUGE MACHINES WHICH HAVE BEEN INSTALLED AND TESTED AT OAK RIDGE, TENNESSEE OVER THE YEARS. GARRETT WAS A MAJOR

CONTRIBUTOR IN BRINGING THE CENTRIFUGE MACHINE TO ITS PRESENT STATE OF PRODUCTION READINESS FOR INSTALLATION IN THE GAS CENTRIFUGE ENRICHMENT PLANT (GCEP) AT PORTSMOUTH, OHIO.

IN ORDER TO FULFILL THE CHALLENGE OF MASS PRODUCING AND TESTING GAS CENTRIFUGE MACHINES FOR INSTALLATION IN THE GCEP, WE HAVE LEASED AN INACTIVE GOVERNMENT FACILITY AT SANDUSKY, OHIO AND HAVE EXPENDED TO DATE $17.5 MILLION TO MODIFY THE BUILDING TO OUR SPECIFIC REQUIREMENTS. SUBSTANTIVE EMPLOYMENT HAS ALREADY OCCURRED. $100 MILLION OF ADDITIONAL GARRETT CORPORATION INVESTMENT WILL BE REQUIRED TO CONSTRUCT THE NECESSARY EXPANDED FACILITIES SUITABLE FOR PHASE II PRODUCTION. BEYOND THAT, IT IS ANTICIPATED THAT BETWEEN 1500 AND 2000 NEW JOBS WILL BE CREATED IN THIS LABOR-DEPRESSED AREA DURING THIS PHASE OF THE GCEP PRODUCTION. OVER AND ABOVE THE SANDUSKY INVESTMENT, $15 MILLION HAS BEEN SPENT FOR CAPITAL, FACILITIES AND EQUIPMENT AT OUR TORRANCE, CALIFORNIA PLANT. THIS EXPENDITURE WAS REQUIRED TO SUPPORT AND SUSTAIN BOTH THE DEVELOPMENT AND THE PRODUCTION PHASES OF THE PROGRAM WHICH WE FEEL MUST BE CONTINUED TO REALIZE THE ULTIMATE POTENTIAL OF THE CENTRIFUGE.

MY PURPOSE IN MENTIONING THE EXTENT OF OUR FINANCIAL INVESTMENTS AND DURATION OF OUR EFFORTS IS TO ESTABLISH THE MAGNITUDE OF THE GARRETT CORPORATION COMMITMENT AND THE DEPTH OF OUR DEDICATION TO THIS IMPORTANT NATIONAL PROGRAM.

AS A HIGH-TECHNOLOGY COMPANY, IN BUSINESS FOR OVER 40 YEARS, GARRETT IS NOT UNFAMILIAR WITH MAKING SIGNIFICANT FINANCIAL COMMITMENTS IN THE COURSE OF PURSUING NEW BUSINESS VENTURES. IF THE PARTICULAR PROGRAM REQUIRES CONTINUED COMMITMENT OVER AN EXTENDED PERIOD OF TIME, WE CONSTANTLY REVIEW THE PREVAILING CONDITIONS, COMPARE THEM TO OUR CURRENT BUSINESS GOALS, AND DETERMINE THE FEASIBILITY OF COMPLETION. IT IS NOT AN INFREQUENT EVENT IN OUR BUSINESS ENVIRONMENT THAT CONDITIONS

CHANGE OVER THE COURSE OF A MULTI-YEAR PROGRAM. IT COMES AS NO SURPRISE THAT A "RE-CALIBRATION" OF GCEP VIABILITY IS TAKING PLACE IN THE CURRENT NUCLEAR INDUSTRY SLOWDOWN AND GOVERNMENT BUDGET REVIEW CLIMATE.

HOWEVER, THE DEPARTMENT OF ENERGY'S ENRICHMENT FUNCTION IS TRULY UNIQUE, IN THAT IT IS VITALLY CONCERNED WITH NUCLEAR NON-PROLIFERATION AND CLASSIFIED TECHNOLOGY CONSIDERATIONS, WHILE SIMULTANEOUSLY MAINTAINING A MARKETING ORGANIZATION, COMPETING IN AN OPEN WORLD-WIDE MARKET, CONDUCTING R&D, AND PAYING FOR ITS OWN OPERATION AND EXPANSION THROUGH THE REVENUES GENERATED FROM ENTERPRISE EFFORTS. WE NOTE APPROVINGLY THAT DOE ENRICHMENT SERVICE MANAGEMENT INCREASINGLY MODELS ITS OPERATION ON INDUSTRIAL PRACTICES THROUGH THE GENERATION OF ANNUAL REPORTS CONTAINING BALANCE SHEETS AND PROFIT OR LOSS DATA.

IN 1979 THE GOVERNMENT ASKED PRIVATE INDUSTRY TO JOIN THEM IN THEIR ENTERPRISE BY ESTABLISHING AN INDUSTRIAL BASE FOR GAS CENTRIFUGE PRODUCTION. INDUSTRY ASSESSED THE BUSINESS RISKS VERSUS THE POTENTIAL FOR SUCCESS AND RESPONDED FAVORABLY. THIS DECISION AT GARRETT INVOLVED EXPENDITURE OF A VERY SIZABLE AMOUNT OF PRIVATE CAPITAL. WE ARE SURE THAT THE OTHER GCEP SELECTED EQUIPMENT SUPPLIERS ALSO MADE CORRESPONDING OUTLAYS.

WITH THE STATED CONSIDERATIONS IN MIND, I RESPECTFULLY SUBMIT THAT THE MEMBERS OF CONGRESS PLAY A VITAL ROLE IN PROTECTING THE VIABILITY OF A MULTI-BILLION DOLLAR GOVERNMENT-CONTROLLED ENTERPRISE WHICH ULTIMATELY SHOULD BE VIEWED AS A NATIONAL ENERGY ASSET. THE DECISION ON GCEP FUNDING HAS FAR-REACHING IMPLICATIONS AND MUST BE ROOTED IN BASIC BUSINESS PRINCIPLES THAT INCLUDE A WHOLE ARRAY OF JUDGMENTAL FACTORS BEYOND THOSE OF ANY COST MODEL.

FROM GARRETT'S VIEWPOINT, WE THINK THE CONGRESS MUST INCLUDE IN ITS CONSIDERATION THE COGENCY OF THE FOLLOWING FACTORS.

- o THE PRODUCT PROTECTS DOE'S CORE BUSINESS IN ENRICHMENT SERVICE BY PROVIDING ASSURED CAPACITY AT THE LOWEST COST.

- o GCEP EMBODIES THE LATEST PROVEN ENRICHMENT TECHNOLOGY SUFFICIENTLY DEVELOPED FOR COST-EFFECTIVE PRODUCTION.

- o GCEP WILL ULTIMATELY PROVIDE A SEPARATIVE WORK COST BASE WHICH WILL PERMIT COMPETITIVE PRICING IN THE DOMESTIC AND INTERNATIONAL MARKETPLACE. THE ABILITY TO COMPETE AGGRESSIVELY AND SUCCESSFULLY IN THE WORLD MARKET IS A SIGNIFICANT ELEMENT IN PROVIDING A POSITIVE CONTRIBUTION TO THE U.S. BALANCE-OF-PAYMENTS POSITION. WITH THE DEVELOPMENT OF FOREIGN ENRICHMENT COMPETITORS, THE PRICE OF SWU'S (BOTH NEAR-TERM, AND OVER THE LIFE OF THE CONTRACT) HAS BECOME A MAJOR FACTOR IN THE SALES EFFORT TO POTENTIAL FOREIGN CUSTOMERS. GREAT DILIGENCE WILL BE NECESSARY TO ENSURE CONTINUATION OF SUPPLY CONTRACTS EVEN WITH DOMESTIC USERS.

- o IN AN OVERALL ENRICHMENT ENTERPRISE THAT INCLUDES GCEP, A POSITIVE CASH FLOW CAN BE MAINTAINED. WITHOUT GCEP, THE COST INCREASES FOR POWER ACTUALLY EXPERIENCED RATHER THAN POSTULATED MAY WELL CREATE AN EVEN GREATER EROSION OF THE U.S. SHARE OF THE MARKET. GCEP HAS BEEN PAID FOR TO DATE, AND CAN CONTINUE TO BE FULLY FINANCED BY ENRICHMENT REVENUES IF AN AGGRESSIVE ATTITUDE IS REFLECTED ON A CONSISTENT BASIS BY THE CONGRESS AND THE U.S. GOVERNMENT ENTITIES RESPONSIBLE FOR URANIUM ENRICHMENT SERVICES.

- PRESERVATION OF SWU-CUSTOMER AND PLANT EQUIPMENT-SUPPLIER RELATIONSHIPS IS A SIGNIF.CANT FACTOR IF THE GOVERNMENT PLANS TO CONTINUE THE ENRICHMENT ENTERPRISE ON A SOUND BUSINESS BASIS. IN THE CASE OF CUSTOMERS, THEY WILL REACT POSITIVELY TO ACTIONS THAT REAFFIRM A U.S. COMMITMENT TO AN ADEQUATE, RELIABLE LOW-COST SWU SUPPLY. WHEREAS SUPPLIERS WITH LARGE PRIVATE INVESTMENTS AT STAKE REACT ADVERSELY TO ANY INDICATION OF A LACK OF LONG-TERM RESOLVE. OBVIOUSLY, LOSS OF THE SUPPLIER BASE CAN ONLY RESULT IN PROJECT FAILURE. IN ORDER TO ILLUSTRATE THE POTENTIAL "RIPPLE" EFFECT THAT MAJOR REDUCTION IN GCEP CONSTRUCTION PLANS COULD CAUSE, I WOULD LIKE TO SUBMIT FOR THE RECORD A DOCUMENT SUMMARIZING THE DISTRIBUTION OF GCEP CONTRACTS TO DATE. (ATTACHMENT I) IT WILL BE QUICKLY SEEN THAT 41 OF THE 50 STATES ARE AFFECTED.

- THE GCEP PROJECT ENCOURAGES AND REFLECTS A POSITIVE SOCIAL AND ENVIRONMENTAL CONSCIOUSNESS THROUGH ITS ABILITY TO GENERATE SWU'S WHILE USING 1/20TH OF THE ELECTRICITY REQUIRED BY THE DIFFUSION PROCESS. EVEN IF ONE WERE TO ACCEPT AS VALID THAT OUR FUTURE SWU REQUIREMENTS INTO THE 1990'S COULD BE SATISFIED BY THE DIFFUSION PLANTS, IT WOULD BE APPROPRIATE IN TODAY'S CONSERVATION-MINDED SOCIETY TO REPLACE ON A PLANNED NEAR-TERM ATTRITION BASIS THE OUTDATED DIFFUSION CAPACITY WITH THE MORE ENERGY-EFFICIENT CENTRIFUGE PROCESS, THEREBY FREEING UP MULTI-MEGAWATTS OF ALREADY INSTALLED GENERATING CAPACITY FOR COMMERCIAL AND INDUSTRIAL EXPLOITATION.

- THE GOVERNMENT'S DECISION TO PROCEED WITH GCEP WAS ACCOMPANIED BY COMMITMENTS TO DOE CUSTOMERS, PLANT EQUIPMENT SUPPLIERS AND EMPLOYEES OF THE ENRICHMENT PRODUCTION FACILITIES. THESE COMMITMENTS WERE MADE AND ACCEPTED IN GOOD FAITH. A REPUTABLE

BUSINESS HAS THE RESPONSIBILITY TO FULFILL SUCH OBLIGATIONS. IN THIS INSTANCE THE U.S. GOVERNMENT IS THE PRIMARY CONTROLLER OF THE ENTERPRISE.

- o GCEP HAS THE TECHNOLOGY IN HAND, THE PROJECT IS ON SCHEDULE AND WELL WITHIN BUDGET, AND NEARLY 1.5 BILLION DOLLARS OF PUBLIC MONEY HAS BEEN APPROPRIATED TO DATE FOR ITS CONSTRUCTION; AND WHILE AN UNDESIRABLE SOFTENING OF THE SWU MARKET HAS OCCURRED, IT CERTAINLY HAS NOT DISAPPEARED ALTOGETHER. WITH JUST THE ORDERS ON HAND IN DOE, A LOGICAL APPROACH WOULD BE AN AUTHORIZATION FOR CONSTRUCTION OF THE FULL EIGHT-BUILDING GCEP PLANT ON THE PRESENT OR EVEN AN ACCELERATED SCHEDULE, WHILE PHASING OUT THE DIFFUSION PLANTS UNDER AN EARLY RETIREMENT PLAN. A CONTINUATION OF THE PRESENT AGGRESSIVE U.S. MARKETING EFFORT SHOULD CERTAINLY BE A PART OF ANY SUCH ENTERPRISE PLAN.

I HAVE READ THE RECENT GAO REPORT AND THE CONGRESSIONAL RESEARCH SERVICE STUDY WITH INTEREST. THEY BOTH DRAW CONCLUSIONS BASED UPON APPLIED FACTORS, PROJECTED COSTS, AND FORECASTED DEMAND OR LACK THEREOF. THEY ALSO USE VARIOUS OTHER STUDIES AND PUBLISHED MATERIAL TO SUBSTANTIATE THEIR SUPPOSITIONS. THE DEPARTMENT OF ENERGY HAS BEEN FORCED TO REPLY TO THESE STATED OPINIONS BY RESPONDING IN KIND, WITH DATA DRAWN FROM DOE'S OWN SOURCES. IN SOME INSTANCES BOTH DOE AND THE CONGRESSIONAL COMMITTEE STAFF SERVICES USED THE SAME SOURCE DATA BUT DREW DIFFERING CONCLUSIONS. GARRETT SUGGESTS THAT THE PRIME CONSIDERATIONS AT THIS POINT IN TIME, ON THE FUTURE OF GCEP SHOULD NOT BE CONFINED EXCLUSIVELY TO COMPUTER MODELS INTERPRETATION, BUT THAT THE BUSINESS JUDGMENTAL FACTORS WE HAVE NOTED SHOULD RECEIVE SUBSTANTIVE CONSIDERATION AS WELL. TO SUMMARIZE:

- o GCEP PROTECTS DOE'S CORE ENRICHMENT SERVICE BUSINESS
- o GCEP UTILIZES COST-EFFECTIVE ADVANCED TECHNOLOGY
- o GCEP ASSURES A COMPETITIVE SWU COST BASE
- o GCEP PERMITS CONTINUING THE POSITIVE CASH FLOW OF THE U.S. ENRICHMENT ENTERPRISE TO PROTECT AGAINST FUTURE POWER COST INCREASES
- o GCEP PRESERVES VITAL CUSTOMER AND SUPPLIER RELATIONSHIPS
- o GCEP ENCOURAGES A POSITIVE SOCIAL/ENVIRONMENTAL CONSCIOUSNESS
- o GCEP HONORS GOVERNMENT COMMITMENTS
- o GCEP PERFORMANCE TO DATE MERITS FULL PLANT CONSTRUCTION CONTINUATION

MR. CHAIRMAN AND MEMBERS OF THE COMMITTEE, GARRETT CORPORATON COMMENTS TODAY HAVE OBVIOUSLY REFLECTED MORE SUBJECTIVE BUT NO LESS REAL CONCERNS THAT THE SEEMINGLY MORE QUANTIFIABLE KINDS OF MATERIAL GENERATED BY BOTH LEGISLATIVE AND EXECUTIVE BRANCH ORGANIZATIONS DEALING WITH GCEP BUDGET CONSIDERATIONS. HOWEVER, IN ADDITION TO ECONOMIC MODELING, THE BUSINESS PRINCIPLES WE HAVE OUTLINED IN OUR COMMENTS TODAY HAVE SERVED OUR COMPANY EXCEEDINGLY WELL IN THE PAST ON OTHER PROJECTS TO HELP DECIDE IMPORTANT ISSUES IN AN UNCERTAIN ENVIRONMENT. WE HOPE THAT SHARING THEM WITH YOU WILL BE TO OUR MUTUAL BENEFIT IN THE EVENTUAL UNIMPEDED COMPLETION OF GCEP. ONE FINAL THOUGHT WE WOULD ASK YOU TO REFLECT UPON - IT IS PARADOXICAL TO OUR CUSTOMARY MODE OF THINKING AND REACTING THAT ONE OF THE MOST SUCCESSFUL CASH FLOW GENERATORS IN THE HISTORY OF GOVERNMENT-OPERATED ENTERPRISES SHOULD BECOME UNNECESSARILY CONSTRAINED IN A PROPER EFFORT TO IMPROVE ITS WORLD-WIDE COMPETITIVE POSTURE; EXPLOIT AVAILABLE, PROVEN GROWTH TECHNOLOGY; ASSIST IN OFFSETTING AN UNDESIRABLE BALANCE-OF-TRACE POSITION AND REDUCE THE EXTRAORDINARY ENERGY CONSUMPTION OF THE GASEOUS DIFFUSION PROCESS. GENTLEMEN, THIS CONCLUDES GARRETT'S COMMENTS FOR TODAY.

ATTACHMENT I TO
GARRETT CORPORATION TESTIMONY
SUBCOMMITTEE ON ENERGY RESOURCE AND DEVELOPMENT

GCEP PROJECT FUNDS; IMPACT ANALYSIS BY STATE

ATTACHED IS A PACKET OF MATERIALS INDICATING THE CURRENT DISTRIBUTION OF DOLLARS BY STATE OF THE GCEP PROJECT CONGRESSIONAL FUNDING TO DATE.

THE FIRST PAGE REFLECTS THE TOTAL CONTRACT VALUE IN DOLLARS AND BY STATE. ONLY DIRECT AND SIGNIFICANT GCEP CONTRACTS AND SUBCONTRACTS ARE ACCOUNTED FOR IN THE TOTAL DOLLARS INDICATED. THESE FIGURES, HOWEVER, DO NOT REFLECT "SECOND LEVEL" COMMUNITY INCOME CONTRACTS THAT RESULT BECAUSE OF GCEP CONTRACTS.

THE NEXT TWO PAGES REFLECT THE DISTRIBUTION OF CONTRACT FUNDS GRAPHICALLY TO STATES WHO HAVE RECEIVED CONTRACT FUNDS AS INDICATED ON THE UNITED STATES MAPS, WITH THE SECOND MAP REFLECTING THE ACCOUNTABLE FUNDS BY STATE AS OF THIS DATE. THESE MAPS INDICATE THAT ONLY A MINOR NUMBER (9) OF THE STATES HAVE NOT BEEN DIRECTLY IMPACTED AS A RESULT OF GCEP CONTRACT AWARDS. THE NUMBER OF STATES NOT RECEIVING DISTRIBUTION OF FUNDS COULD BE LESS BECAUSE OF SUB-TIER CONTRACTS UNKNOWN AT THE PROJECT AND PRIME CONTRACTOR LEVEL.

THE BALANCE OF THE MATERIAL REFLECTS THE DETAILED DATA LISTINGS OF THE GCEP PROJECT CONTRACTORS WITH CONTRACTOR VALUES BY STATE.

THIS DOCUMENT INDICATES THAT CURRENTLY GCEP DIRECT CONTRACTS FUNDED TO DATE EXCEED $1.2 BILLION AND ARE SPREAD OVER SOME FORTY-ONE (41) STATES.

GCEP IMPACT BY STATE

State	Contract Value (X$1000)
Alabama	17,880
Arizona	2
California	249,419
Colorado	2,311
Conneticut	5,624
Delaware	7
District of Columbia	651
Florida	1,042
Georgia	14,864
Illinois	8,408
Iowa	168
Indiana	2,874
Kansas	2
Kentucky	126
Maryland	5,329
Massachusetts	2,461
Michigan	5,686
Minnesota	2,595
Mississippi	17
Missouri	1,989
Nevada	3
New Hampshire	4
New Jeresy	3,041
New Mexico	322
New York	4,706
North Carolina	8,496
Ohio	403,548
Oregan	8
Pennsylvania	39,486
Rhode Island	1,163
South Carolina	60
South Dakota	2
Tennessee	306,461
Texas	40,527
Utah	10
Vermont	24
Virginia	30,527
Washington	87,896
West Virginia	2,027
Wisconsin	583
Wyoming	7
Total	1,250,292

Contracted dollars are represented to the subcontract of the prime contract level.

PROJECT IMPACT

CONSTRUCTION, PROCUREMENT AND MACHINE CONTRACTS

GAS CENTRIFUGE ENRICHMENT PLANT

CONTRACT VALUES*

LEGEND

CONTRACT VALUE (x1000)

* ESTIMATE OF DOLLAR VALUE OF WORK BEING PERFORMED AS OF 3/12/82

NATIONWIDE TOTALS

CONTRACT VALUE: $1,250.3 MILLION

GCEP IMPACT BY CITY AND STATE

STATE MICHIGAN

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Detroit	Building/ Equipment	Detrex	38	
Ann Arbor	Building/ Equipment	Electro Arc	6	
Iron Mountain	Rigid Mast Crane	Lake Shore	983	
Sparta	G-17 Valve	Westran Corporation	197	
Iron Mountain	IPT & TT	Lake Shore	1,881	
Ann Arbor	15 KV Electrical	Phelps Dodge Cable & Wire Company	519	
Southfield	Transfer Corridor Shell & Steel Subcontractor	Inryco, Inc.	296	
Jackson	Title I & II Design	Commonwealth	1,638	
Iron Mountain	Tow Tractor Intra	Lake Shore, Inc.	96	
Unidentified	Misc Comp-BEC	Dow Corning Corporation	32	

GCEP IMPACT BY CITY AND STATE

STATE MINNESOTA

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Minneapolis	MOP Proto	Onan Corporation	335	
Minneapolis	Building/ Hardware	RMS	250	
Minneapolis	Building/ Hardware	Miscellaneous	65	
Minneapolis	Biaxial Seismic Shaker	MTS System Corp.	1,938	
Unidentified	Misc Comp-BEC	Research Inc.	5	
Unidentified	Misc Comp-BEC	Despatch Inc.	2	

GCEP IMPACT BY CITY AND STATE

STATE MISSISSIPPI

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Unidentified	R & D	Middle South Computer Exchange	2	
Unidentified	FA - R & D	Sound & Communications	15	

GCEP IMPACT BY CITY AND STATE

STATE MISSOURI

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Washington	Building/ Equipment	Zero Manufacturing	288	
St Louis	R/A & CTTF Steel Fab	Mississippi Valley Structural Steel	1700	
St Louis	Misc Procure-ment	Lincoln St Louis	1	

GCEP IMPACT BY CITY AND STATE

STATE NEW JERSEY

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Fairfiled	Equipment for AiR	Electro-Nucleonics	709	
Fairfield	Test Equipment	Electro-Nucleonics	717	
Unidentified	Transformer	Allegheny Ludlow	90	
Daramus	R/A & CTTF Found & U/G	Titan Group Inc./Quest II	551	
Point Pleasant	R/A & CTTF Found & U/G Subcontract	New England Drilling	70	
Newark	Bldg/Equip.	Yale	7	
Unidentified	Spray Tunnel	Blickman Fab.	217	
Fairchild	Eng. Service	Electro-Nucleonics	141	
Fairchild	Hardware	Electro-Nucleonics	225	
Fairchild	Prototype	Electro-Nucleonics	311	
Unidentified	Misc Comp-BEC	Kulite Semi-Conductor Products	1	
Unidentified	Misc Comp-BEC	Waddell Equip. Co.	2	

GCEP IMPACT BY CITY AND STATE

STATE NEW MEXICO

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Los Al Amos	(Study) LASL Diagnostic Studies	Los Alamos Scientific	320	
Unidentified	Misc Comp-BEC	Eberline	2	

GCEP IMPACT BY CITY AND STATE

STATE NEW YORK

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Rochester	Components	CVC Products	64	
Rochester	Small Sub-assemblies	Miscellaneous	167	
New York City	Equip/Facil.	Miscellaneous	1000	
Ballston Spa	Equip/Facil.	Miscellaneous	500	
Rochester	Bldg/Hardware	CVC Products	600	
White Plains	Bldg Equip/ Mach.	IBM	242	
Elmira	Bldg Equip/ Mach.	Harding	21	
Long Island	MDP/MVIP Proto Testing	Dayton T. Brown	100	
Liver Pool	PB#1 HVAC Subcontractor	Cambridge Filter Corp.	56	
Unidentified	Misc Comp-BEC	AiResearch	1730	
Unidentified	Computer Term	Goodyear	3	
Unidentified	Rotor Bal. Computer Sys	Goodyear	209	
Unidentified	Misc Comp-BEC	PBC Piezotronics	3	
Unidentified	Misc Comp-BEC	Kistler Instru. Co.	1	
Unidentified	Misc Comp-BEC	EMI Gencom, Inc.	1	
Unidentified	Misc Comp-BEC	Presray	9	

GCEP IMPACT BY CITY AND STATE

STATE NORTH CAROLINA

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Raleigh	P.B. X-3002 Struct. Steel	Peden Steel Co.	8483	
Unidentified	Misc Comp-BEC	Carolina Foundry	3	
Unidentified	Misc Comp-BEC	Crucible Steel	6	
Unidentified	Misc Comp-BEC	Measurements Group	2	
Unidentified	Misc Comp-BEC	James L. Highsmith, Co.	2	

GCEP IMPACT BY CITY AND STATE

STATE OREGON

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Unidentified	BM-R&D	Magnetic Specialties	8	

GCEP IMPACT BY CITY AND STATE

STATE PENNSYLVANIA

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Heidleburg	R/A & CTTF Steel	Erwin L. Smith Baumann Division	940	
Bethlehem	R/A & CTTF Steel	Bethlehem Steel	1800	
Pittsburgh	R/A & CTTF Roofing & Siding Subc.	E. G. Smith Division	2000	
Bethel Park	R/A & CTTF Roofing & Siding Subc.	Tri-City Electric Co.	360	
Pittsburgh	MIV Prod.	Kerotest Mfg.	8520	
Pittsburgh (1) Bethel Park (1)	PB#1 Subcont.	Various Subcontractors	1290	
Bethel Park	GCEP Admin. Bldg. Subc.	Tri-City Electric Co.	510	
Imperial	GCEP Substa. & Switchhouse Subcon.	MET Electrical Testing, Inc.	73	
Imperial	Substa. Module Subcon.	MET Electrical Testing, Inc.	35	
Pittsburgh	Service Mod. Assy. Subcon.	Alco	325	
Monroeville	PB#1 Fire Protection	Grunau Co.	1051	
Bethel Park	Sewate Trtmt. Subcon.	Tri-City Electric Co.	336	
Philadelphia	Sewage Trtmt. Subcon.	Johnson Controls	122	
Bethel Park	Outside U/G Util. Subcon.	Tri-City Electric Co.	2000	
Bethel Park	Transfer Corr. Shell & Steel Subcontractor	Tri-City Electric Co.	50	

GCEP IMPACT BY CITY AND STATE

STATE PENNSYLVANIA (Cont'd)

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Folcroft	Machine Corp.	Tura Machine Corp	13	
Pittsburgh	Building/ Steel	Lukens Steel	450	
Unidentified	Misc Comp-BEC	Leybold-Heraeus Vacuum Products	3	
Pittsburgh	Bldg/Equip.	Weld Tooling	1	
Unidentified	Misc Comp-BEC	Raco International Inc.	2	
Philadelphia	Bldg/Equip	Stokes	7	
Pittsburgh	Bldg/Equip	Jones/Loughlin	24	
Blue Bell	Bldg/Equip	Sperry Rand	356	
Philadelphia	Bldg/Equip	Stokes	54	
Philadelphia	Title I & II Design	Catalytic	15453	
Philadelphia	SF6 Gas Transfer Cart	Limco Mfg. Corp.	63	
Wayne	Vertical Pump Assemblies	Worthington Group	610	
Bethlehem	Outside Serv.	Miscellaneous	1500	
Unidentified	Contour Burner	Goodyear	1	
Unidentified	Vacuum Pumps	Stokes	7	
Unidentified	Misc Comp-BEC	Aluminum Co. of America	1	
Unidentified	2 Workpieces	Goodyear	330	
Pittsburgh	Mach. Isol. Prototype	Kerotest Mfg. Corp.	349	

GCEP IMPACT BY CITY AND STATE

STATE PENNSYLVANIA (Cont'd)

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Unidentified	Rotor Central.	ARC Mfg. Co, Inc	140	
Unidentified	Probe Mount Assembly	ARC Mfg. Co, Inc.	212	
Unidentified	(Study)	Alcoa	450	
Unidentified	Hardware	Alcoa	634	
Unidentified	Misc Comp-BEC	Standard Pressed Steel	7	
Unidentified	Misc Comp-BEC	Tinius Olsen Test. Machine Co.	7	

GCEP IMPACT BY CITY AND STATE

STATE RHODE ISLAND

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Providence	CIV Proto	EG&G Sealol/Eagle	94	
Unidentified	G-17 Bellows Assembly	G. W. Dahl Co., Inc.	805	
Providence	Sample Sys. Block Valves	EG&G Sealol Eagle	109	
Providence	Mach. Isol. Valve Proto.	EG&G Sealol Eagle	154	
Unidentified	Misc Comp-BEC	Leybold-Heraeus Vacuum Products	1	

GCEP IMPACT BY CITY AND STATE

STATE SOUTH CAROLINA

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Florence	Bldg/Equip	Linde	25	
Spartenburg	Bldg/Equip	Lockwood Green	35	

GCEP IMPACT BY CITY AND STATE

STATE TEXAS

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Garland	MDP Proto	Varo	357	
Dallas	P.B. X-3001	Dynamic Industrial Const.	40095	
Unidentified	Misc Comp-BEC	Lubri Kote	7	
Unidentified	Misc Comp-BEC	Varian	1	
Unidentified	Misc Comp-BEC	Bramner Standard Co.	3	

GCEP IMPACT BY CITY AND STATE

STATE UTAH

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Unidentified	Misc Comp-BEC	American Metal Enter., Inc.	10	

GCEP IMPACT BY CITY AND STATE

STATE VIRGINIA

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Bristol	R/A & CTTF	Bristol Steel & Iron Works	2318	
Richmond	Bldg/Steel	Force	400	
Blacksburg	Bldg/Steel	Litton	150	
Bristol	R/A & CTTF Struc. Steel	Bristol Steel	18687	
Bristol	Furnish & Erect Struc. Steel, P.B. X-3001	Bristol Steel	8701	
Richmond	Equip & Services CIV	Wyle Laboratories	266	
Unidentified	Misc Comp-BEC	Mosler Safe Co.	5	

GCEP IMPACT BY CITY AND STATE

STATE WASHINGTON

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Richland	Equip/Facil.	Misc.	2300	
Seattle	Mach. Compon.	Aircraft Standards	7	
Kent	Mach. Compon.	B&H Machine	57	
Kent	Mach. Compon.	B&H Machine	86	
Auburn	Mach. Compon.	Kent Precision	11	
Seattle	Mach. Compon.	Rainier Rubber	3	
Seattle	Mach. Compon.	University Swaging	104	
Seattle	Mach. Compon. Manu/Assemb/ Support	Boeing	80434	
Unidentified	Misc Comp-BEC	AiResearch	2300	
Seattle	Hardware	Boeing Engr & Construction	998	
Seattle	Material	Boeing Engr & Const.	280	
Seattle	Site	Boeing Engr & Const.	427	
Seattle	Electromagnet. Interface	Boeing Engr & Const.	100	
Seattle	Labor & Matl. Test Tech. Alloy and Weld	Boeing Engr. & Const.	225	
Kent	Misc Comp-BEC	B&H Machine, Inc.	17	
Unidentified	Misc Comp-BEC	Systems Northwest	191	
Seattle	Misc Comp-BEC	Spencer Acft. Ind.	136	
Unidentified	Misc Comp-BEC	Intercoastal Inc.	22	
Unidentified	Misc Comp-BEC	Kilsby Tube Supp.	20	
Unidentified	Misc Comp-BEC	Kilsby Tube Supp.	68	

GCEP IMPACT BY CITY AND STATE

STATE WASHINGTON (Cont'd)

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Unidentified	Misc Comp-BEC	Kilsby Tube Supp.	75	
Unidentified	Misc Comp-BEC	Hipotronics	1	
Unidentified	Misc Comp-BEC	VWR Scientific	4	
Unidentified	Misc Comp-BEC	Scientific Supply & Equip. Inc.	2	
Unidentified	Misc Comp-BEC	Intercoastal Inc.	2	
Unidentified	Misc Comp-BEC	U.S. Design & Sales, Inc.	1	
Unidentified	Misc Comp-BEC	Teledyne Analytical Inc.	5	
Unidentified	Misc Comp-BEC	Lukas Machine, Inc.	11	
Unidentified	Misc Comp-BEC	Sunstrand Data Control	1	
Unidentified	Misc Comp-BEC	Alcan Aluminum Corp.	3	
Unidentified	Misc Comp-BEC	Drantz	5	

GCEP IMPACT BY CITY AND STATE

STATE WEST VIRGINIA

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Charleston	Process Bldg. #1 Subcon.	Tri-State Roofing	980	
Huntington	Process Bldg. Fluor Mod. Subcontractor	Steel Service	490	
St. Albans	R/A & CTTF Found and U/B Subcon.	Steel Services Co.	430	
Charleston	Transfer Corridor Shell & Steel Subcontractor	Tri-State Roofing Co.	125	
Unidentified	Misc Comp-BEC	Preiser Scientific Inc.	2	

GCEP IMPACT BY CITY AND STATE

STATE WYOMING

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Unidentified	Misc Comp-BEC	Mearl Williams	5	
Unidentified	Components	Preiser Scientific Inc.	2	

GCEP IMPACT BY CITY AND STATE

STATE WISCONSIN

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
La Crosse	Build/Equip.	Trane	13	
Milwaukee	Bldg/Equip.	Bushman	4	
Wasau	PC#1 Diesel Gen. Subcon.	Marathon	48	
La Crosse	PB#1 HVAC Subcontractor	Trane	518	

GCEP IMPACT BY CITY AND STATE

STATE VERMONT

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Sringfield	Optical Co.	Jones & Lanjon Co	24	

GCEP IMPACT BY CITY AND STATE

STATE KANSAS

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Edwardsville	Procurement-	C. Teeant Co.	2	

GCEP IMPACT BY CITY AND STATE

STATE SOUTH DAKOTA

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Aberdine	Procurement-BEC	K. O. Lee, Co.	2	

GCEP IMPACT BY CITY AND STATE

STATE NEVADA

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Minden	Procurements-BEC	Bently Nevada Corp.	3	

GCEP IMPACT BY CITY AND STATE

STATE NEW HAMPSHIRE

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Nashua	Procurements-BEC	Digital Equip. Co.	2	
Portsmouth	Procurements-BEC	Mettler Inc.	1	
Manchester	Procurements-BEC	Sorinson Co.	1	

GCEP IMPACT BY CITY AND STATE

STATE ARIZONA

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Phenoix	FA - R&D	Motorola Literature Center	1	
Temple	FA Procure.	Jensen Tools & Alloys	1	

GCEP IMPACT BY CITY AND STATE

STATE TENNESSEE

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Oak Ridge	GCEP Support	INDEE Co.	2	
Oak Ridge	Systems Support Contractor	SOC/DMJM	8,603	
Oak Ridge	Customer Support	Garrett	169	
Oak Ridge	Small Sub-assemblies	Misc.	167	
Oak Ridge	Machine Components	Chambers Tool	4.1	
Kingston	Machine Components	Kingston Tool and Die	37	
Oak Ridge	Machine Components	Oak Ridge Tool--Engr.	1,518	
Oak Ridge	Machine Components	Ridge Metals	192	
Oak Ridge	Building/ Hardware	Oak Ridge Tool	400	
Oak Ridge	Building/ Hardware	Misc.	10	
Oak Ridge	GCEP Related Jobs	Rust Engineering	9,400	
Oak Ridge	Operating Contractor	UCC-ND	81,257	
Knoxville	BPCV, Prototype	Robertshaw	2,724	
Knoxville	BPCV	Robertshaw	230	

GCEP IMPACT BY CITY AND STATE

STATE TENNESSEE

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Knoxville	MIV Sys.	Robertshaw	96	
Lewisburg	MVIP Proto.	Teledyne-Lewisburg	431	
Chattanooga	Service Mod. Assy. Subcontr.	Siskin Steel	185	
McMinnville	Outside U/G Util. Subcontr.	Tennessee Metal Fabricating Corp.	892	
Oak Ridge	Project Management	DOE	3,770	
Oak Ridge	Building Construction	Boeing	60,000	
Oak Ridge	Machine Assemblies	Airesearch	737	
Oak Ridge	GCEP Support	Richard P. Jones Co.	1	
Chattanooga	Instrument Cabinet & panels	Elec. Systems	161	
Oak Ridge	RBCS Casing Assembly	Oak Ridge Tool--Eng.	229	
Chattanooga	Instrument Cabinets	Elec. Systems	112	
Oak Ridge	Control & Data Aco. Sys.	Science Applications	858	
		Browning Belting and Supply Co.	1	
		Do All of Tn. Co.	1	
		Tennessee Welding Supply, Inc.	9	
		Tenn. Mobilephone	1	

GCEP IMPACT BY CITY AND STATE

STATE TENNESSEE

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
		Sonoco	2	
		Bob Bales Equip. Co.	2	
		Brownell Electro	4	
Knoxville	Welding	Knoxville Welding Supply	3	
		United Air Specialists	7	
		Apex Office Supply Co.	9	
Knoxville	Misc. Contracts	Safeco	1	
		Keith-Simmons Co.	4	
		Tenn. Mill & Mine	649	
Knoxville	Studies	Water Cond. of Knoxville	1	
		Southeastern Metal Fabrication	24	
		Industrial Belting & Supply Co.	1	
		The Tool Crib	8	
		Francis M. Reid, M.D.	920	
		Hobbs Equip. Co.	11	
		Rental Uniform Co.	3	
		Joseph T. Ryerson & Son	15	
		O'Neal Steel	11	
		Glazer Steel Corp.	2	
		Reynolds Alum. Supply Co.	16	
		Williams & Co.	6	

GCEP IMPACT BY CITY AND STATE

STATE TENNESSEE

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
		Glazer Steel Corp.	16	
		Ridge Metals	14	
		Glazer Steel Corp.	14	
		Glazer Steel	4	
		Precise Tool & Gage Co.	4	
		Electronic Metal Finish Corp.	117	
		PB&S Chemical Co.	3	
		PB&S Chemical Co.	2	
		Hewlett-Packard	21	
Knoxville		Knox Fire Exting.	3	
		Rouser Co., Inc.	2	
		Selox, Inc.	18	
Knoxville		Xerox	4	
		Murrian Co.	13	
		Sherwood Specialties	1	
Knoxville		Knox-Tenn Rental Co.	1	
		3M Business Prod.	1	
		Brownell Electronics	1	
		Parrott Screen Prntg.	3	
		Stillman Elec. Co.	2	
		Ridge Industrial	13	
		Leinarts, Inc.	1	

GCEP IMPACT BY CITY AND STATE

STATE TENNESSEE

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
		Hotsy Equip. Div.	3	
		PB&S Chemical Co.	7	
		Dixie Electronics	21	
		Professional Temp. Services	6	
		Tidi Waste Sys.	1	
		Bondurant Bros. Co.	4	
		E.C. Corporation	100	
		Safety Equip. Distr., Inc.	3	
		Fidelity Sales	4	
		Industrial Electronics	1	
		The Botany Center	1	
Knoxville		Radio Shack	1	
		Mel E. Natheson, Assoc.	1	
		Gailbraith Enterp.	13	
		Allen-Bradley	14	
		Gould, Inc.	5	
		Digital Equip. Corp.	492	
Oak Ridge		Ridge Valve & Fitting	1	
		Bradley-Thompson Tool Co.	5	
		Radio Comm. Systems	1	
		Tactec Sys. Inc.	1	

GCEP IMPACT BY CITY AND STATE

STATE TENNESSEE

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
		Kel-San Prod. Co.	3	
		Stokes Electric	2	
		The Bailey Co.	11	
		Beverly Steel	1,451	
		Adams Craft-Herz Walker	6	
		TAB Products	3	
		Varian Indust. Equip. Gp.	1	
		M.G. Burdett Gas Products	1	
		Dixie Bearing	1	
Knoxville		Safeco	4	
		IBM Corp.	4	
		Ed's Supply Co.	1	
		Trasco	1	
		Fidelity Sales Corp.	1	
		Texas Instruments	7	
		Ferguson Enterprises, Inc.	1	
		Clyde Rudd & Assoc.	2	
		Tektronics, Inc.	29	
		W.A. Brown Co.	4	
		The Bailey Co.	3	
		Mixing Equip. Co.	2	
		Leeds & Northrup	2	

GCEP IMPACT BY CITY AND STATE

STATE TENNESSEE

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
		Hale Trucking Co.	1	
Oak Ridge		Oak Ridge Precision Ind., Inc.	8	
		Air Services	2	
		John A. Meyers, Locksmiths	1	
		Adroit	3	
Knoxville		Knoxville Office Supply	1	
		MAC-[illegible]	2	
		Century Fastener	1	
Oak Ridge	GCEP Support	Union Carbide Corporation	97,000	
Oak Ridge	GCEP Support	SDC/DMJM	8,900	
Oak Ridge	GCEP R & D	Goodyear Aerospace	988	
Oak Ridge	GCEP R & D	Garrett Corp.	1,505	
Oak Ridge	GCEP R & D	Boeing Engineers	21,700	

GCEP IMPACT BY CITY AND STATE

STATE CALIFORNIA

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Santa Monica	Systems Support Contractor	SDC/DMJM	1,062	21
Torrance	Machine Component Manufacturing	Garrett	12,476	147
National City	Components	Master Machine Corp.	97	4
Torrance	Components	Ace Welding	45	1
Los Angeles/ Long Beach	Small Subassemblies	Miscellaneous	2,512	111
Los Angeles	Equipment/ Facilities	Miscellaneous	3,500	1
San Jose	Equipment/ Facilities	Miscellaneous	1,325	1
Torrance	Equipment/ Facilities	Miscellaneous	500	5
El Cajon	Machine Components	Ametek/Straza	380	25
Gardena	Machine Components	B & T Machine	36	3
Los Angeles	Machine Components	California Drop Forge	99	25
Monterey Park	Machine Components	Connor Spring & Mfg.	13	12
Monterey Park	Machine Components	Connor Spring & Mfg.	6	
Placentia	" "	Gencon Plastics	19	2
San Diego	" "	General Atomic	345	20
San Diego	" "	General Atomic	3	
San Diego	" "	General Atomic	45	

GCEP IMPACT BY CITY AND STATE

STATE CALIFORNIA

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Lodi	Machine Components	Lodi Iron Works	37.9	20
Lodi	" "	Lodi Iron Works	8	
Harbor City	" "	McStarlite Company	70	5
La Mirada	" "	Molinas Sheet Metal	53	7
Gardena	" "		2.2	6
Carlsbad	" "	Race Engr. & Mfg.	30.3	5
West Minister	" "	Rodon Products	10	6
Gardena	" "	Rubber Teck Inc.	13	9
Pacorma	" "	Sheets Mfg. Co.	535	4
Pacorma	" "	Sheets Mfg. Co.	12	4
Anaheim	" "	Sonfarrel Co.	37.2	13
Torrance	" "	Spacecraft Machine Prod.	21	4
Torrance	" "	Spacecraft Machine Prod.	61	
Anaheim	" "	Supreme Casting	17.6	8
San Francisco	Building Components	Bechtel	4,048	
Fremont	" "	IHRYCO	400	
Los Angeles	Building/ Steel Hardware	Lodi	278	
Los Angeles	" "	Nardon	150	
Tustin	In-House/Mach/ Equip.	Sony	3	
Santa Barbara	" "	Circon Corporation	18	
Belmont	" "	Vac-O-Blast	20	

GCEP IMPACT BY CITY AND STATE

STATE CALIFORNIA

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Torrance	Operating Contractor	AiResearch	50,580	
Torrance	Equip. for AiR	Commercial Sheet Metal	127	
Los Angeles	CIV	Consolidated Controls	104	
Los Angeles	CIV	Fairchild Stratos Div.	1,014	
*Classified	Material	Vendor I	6,817	
Los Angeles	MIV Prod.	Consolidated Controls	7,171	
Torrance	MVIP Proto.	Garrett/AiR	329	
Los Angeles San Francisco Norco	Low Voltage Substation Subcon.	Various Subcontractors (3)	50	
San Francisco	PB#1 Floor Modules	Bechtel National	2,978	
San Leandra	PB#1 Floor Modules Subcontractor	Nun Royal Electrical Supply	26	
Huntington Beach	Sewage Treatment Subcontractor	Baker Filteration Co.	65	
Gardena	Transfer Corridor Shell & Steel Contractor	Ferguson Door Co., Inc.	370	
San Francisco	Title I & II Design	Bechtel	36,301	
Irvine	Title I & II Design	Fluor	69,231	
San Francisco	Floor Modulco PB x-3001	Bechtel	15,086	
La Mirada	Low Voltage Unit Substations	ITC	1,551	

GCEP IMPACT BY CITY AND STATE

STATE CALIFORNIA

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Santa Fe Springs	R/A Major Crane System	Westmont Industry	8,664	
Los Angeles	Casting	Lodi Lodi	180 227	
Los Angeles	Subcontract	Torr Corp.	500	
-	Hardware	AETH Corp.	570	
Los Angeles	Mach. Isol. Value Proto	Consolidated Controls	477	
Los Angeles	Mach. Value Sets	Consolidated Controls	1,536	
Los Angeles	Hardware	U. of Calif.	755	
-	Equip. for Process Control & Data Sys	Teledyne-Hastings	13,341	
-	Flex. Connectors	Flex. Metal Hose Mfg. Delta Industries	1,031	
Los Angeles	Sensor Manifold Values	Fairchild Industries	213	
Los Angeles	CIV Proto.	Fairchild Ind.	155	
Los Angeles	Diffusion Oil Pump	U. of California	305	
Los Angeles	Labor for Diff. oil Pump	U. of California	160	
-	Diffusion Mechanism	U. of California	105	
Torrence	Mack. Vari. Int. Pleg. Proto.	Airekscarch	418	
-	-	IRI Metalworking	11	

GCEP IMPACT BY CITY AND STATE

STATE CALIFORNIA

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
-	-	IRI Metalworking	6	
-	-	Rubber Teck, Inc.	16	
-	-	Conner Spring & Mfg. Co	1	
		McMaster-Carr supply Co	1	
		Bray Oil Co.	1	
		Pyromet Industries	556	
		Blaisdell Mfg. Inc.	24	
		Castle Metals	42	
		USM Corp.	2	
		Varian IPO Service	2	
		Versatec Corp.	3	
		KR Anderson Co.	16	
		Kevex Corp.	2	
		Endevco, Inc.	2	
		Maja Limited	2	
		Inter. Scientific Instruments	1	
		Vibra Finish Co.	2	
		Harvey Titanium LTD.	2	
		Electrofilm Inc.	4	

GCEP IMPACT BY CITY AND STATE

STATE ALABAMA

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Huntsville	MDP Proto	Chrysler Corporation	595	
Huntsville	MVIP Proto	Chrysler Corporation	629	
Decatur	Service Module Assemblies	Teledyne Brown Engineering	11,623	
Irondale Huntsville (2) Decatur Birmingham	Service Module Assembly Subcon.	Various Subcontractors (6)	3,785	
Cullman	Building/Hardware	Speedring	450	
Decatur	Drum Type Shipping	Wards Foam	192	
Huntsville	Test Prototype Mach. Valve Sets	Wyle Laboratories	594	
Birmingham	Misc.	Whiting Corp.	5	
Birmingham	Misc.	E. Phil Harris Co., Inc.	7	

GCEP IMPACT BY CITY AND STATE

STATE COLORADO

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
La Mirada	Low Voltage Substations	International Transformer	200	
Motebello	Transformers	International Transformer	350	
Elmonte	Circuit Breakers	Westinghouse	800	
Colorado Springs		Kaman Instrument	1	
Colorado Springs	Rotor Disp. Meas. Sys.	Kaman Sciences	341	
Denver	Vacuum Sys. Module	Cryogenic Energy	335	
San Diego	Machine Components	General Atomic	35	
-	-	Weber Metals & Supply Co.	240	
		T.A. Pelsue Co.	2	
		Hach Company	7	

GCEP IMPACT BY CITY AND STATE

STATE CONNECTICUT

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Wallingford	Building/ Steel	Hitchner	300	
Bridgeport	Building/ Equipment	Bullard	234	
Meriden	Recirculating Htg water, Phase I	C.N. Flagg & Co. Inc.	5,077	
		Omega Engr., Inc.	4	
		Barden Corp.	2	
		Enthone, Inc.	1	
		Mitchell Bradford Chem. Co.	1	
		Studer, Inc.	2	
		Liberty Ind.	3	

GCEP IMPACT BY CITY AND STATE

STATE DELEWARE

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
		E.I. Duport	7	

GCEP IMPACT BY CITY AND STATE

STATE DISTRIC OF COLUMBIA

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (xS1000)	REMARKS
Wahington	Program Management	DOE	650	
		Nat'l Bureau of Standards	1	

GCEP IMPACT BY CITY AND STATE

STATE FLORIDA

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Coral Gables	PAO Admin. Bldg.	Fortec Constructors	1,025	
		American Metals Service	9	
		American Metals Service	16	
		Air Pack	2	

GCEP IMPACT BY CITY AND STATE

STATE IOWA

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Muscatine	Bldg./Equipment	Prime	27	
-	Shear Baler, Modified	Al-Jon, Inc.	141	

GCEP IMPACT BY CITY AND STATE

STATE INDIANA

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Gary	PB#1 Floor Modules Subcontractor	R & D Piping	64	
Indianapolis	Fencing & Gates Subcontractor	Robbins Electric Co.	9	
Muncy	R/A & CTTF Steel Fab	Mississippi Valley Structural Steel	1,100	
Gary	R/A & CTTF Steel	U. S. Steel	1,700	
		Star Reloading Co.	1	

GCEP IMPACT BY CITY AND STATE

STATE KENTUCKY

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Elizabethtown	Components	Colt Industries	63	
		Aireasearch	63	

GCEP IMPACT BY CITY AND STATE

STATE MARYLAND

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Sparrow Point	R/A & CTTF Steel	Bethlehem Steel	20	
Hunt Valley	MOP Proto	Westinghouse Electric	211	
Hunt Valley	MVIP Proto	Westinghouse Electric	323	
Silver Spring	CPOTS	Singer/Link	3,774	
Silver Spring	Prepare Sys. Org. CPOTS	Singer Aerospace & Mrue Sys.	1,000	
		Artmore Plastics Corp.	1	

GCEP IMPACT BY CITY AND STATE

STATE MASSACHUSETTS

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Fitchburg	Machine Components	Simonds Cutting Tools	348	
Boston	Building/ Hardware	Simonds	250	
Boston	Building/ Hardware	Miscellaneous	25	
Lexington	Building/ Materials	Varian	49	
Boston	Subcontract	Varian	500	
-	Data Acq. System	Digital Equip. Corp.	122	
-	Purge/Evac Vacuum Pumps	Kinney Vacuum Co.	680	
-	Data Acqui. Sys.	Digital Equip. Corp.	114	
-	Computer Sys.	Digital Equip. Corp.	272	
		Shipley Co.	4	
		Millipore Corp.	4	
		Texas Instru.	83	
		Panametrics	1	
		Barbour-Stockwell	9	

GCEP IMPACT BY CITY AND STATE

STATE GEORGIA

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Atlanta	GCEP Substation & Switchhouse	Cleveland Electrical	3,750	
Atlanta	GCEP Substation & Switchhouse Subcon.	Superior Rigging & Erecting Company	46	
Atlanta	Substation Mods.	Cleveland Electrical	2,403	
Atlanta	Air Plant Cooling Tower & Pumphouse	Cleveland Electrical	8,087	
		Hewlett Packard	1	
-	Vibration Analysis Computer Sys.	Hewlett-Pachard	219	
-	Hardware	Vendor	230	
*	-	Inmac	1	
		Husky Systems	1	
-	-	Weber Tech. Prod.	1	
		VWR Scientific	3	
		Ducommun Metals	2	
		JM Tull Metals	2	
		JM Tull Metals	19	
		JM Tull Metals	37	
		Curtin Matheson Scientific, Inc.	5	
		Yellow Spgs Intri.	1	

GCEP IMPACT BY CITY AND STATE

STATE GEORGIA

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
		Uresco, Inc.	9	
		Hewlett-Packard	47	
		Beckman Instru. Co.	1	
		Blue M Equip. Co.	2	
		J. M. Tull Metals Co.	1	
		Perkin-Elmer	15	
		American Scientific Products	1	

GCEP IMPACT BY CITY AND STATE

STATE ILLINOIS

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Peoria (2)	PB#1 Diesel	Various Subcontractors (3)	725	
Chicago	Transformer Wire	Kagen Dixon	60	
West Chicago	Sewage Treatment Subcontractor	National Hydro Systems, Inc.	47	
Aurora	Outside U/G Util. Subcontractor	Henry Pratt Co.	750	
Chicago	R/A & CTTF Steel	Bethlehem Steel	1,800	
Sterling	R/A & CTTF Steel	Inland Steel	20	
Chicago	R/A & CTTF Steel	Mid-City Steel	940	
Marengo	Machine Components	Arnold Engr. Co.	783	
Chicago	Procurement/ Steel	Naylor Pipe Co.	1,000	
Rosemont	Procurement/ Steel	J & L Steel	600	
Chicago	Procurement/ Steel	Arnold Engr.	850	
Chicago	Procurement/ Steel	Miscellaneous	120	
Blue Island	Equipment/ Machinery	Grieve	49	
Franklin	Equipment/ Machinery	Banks	12	
Des Plaines	Equipment/ Machinery	Loral	33	

GCEP IMPACT BY CITY AND STATE

STATE ILLINOIS

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Aurora	Equipment/ Machinery	Teledyne Pipes	98	
Rockford	Equipment/ Machinery	Greenlee	1	
Aurora	NC Bender	Teledyne Pipes	15	
Chicago	Wreck Disass-embly Equis.	Sciaky Bro., Inc.	109	
Chicago	Water Trace Sys. Module	W. S. Darley & Co. Sciaky Bros., Inc.	347	
-	-	McMaster-Carr	1	
-	-	Williams-White	3	
		Division Lead Co.	10	
		Renishaw-Forbes	26	
		White-Dunstrand Mach. Tool.	4	
		DATA Inc.	1	
		Numerical Algorithms Group, Inc.	1	
		Heidenhain Corp.	3	

GCEP IMPACT BY CITY AND STATE

STATE OHIO

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
ortsmouth (2) orthington roveport olumbus (11) inford	GCEP Administration Building Subcontrs.	Various Subcontr. (16)	2,228	
		Radiant Tech. Corp.	4	
averly ortsmouth oungstown incinnati olumbus	GCEP Substation & Switchhouse Subcon.	Various Subcontractors(5)	1,198	
ortsmouth oungstown	Substation Mods Subcontractors	Various Subcontractors(2)	279	
incinnati	PB#1 Diesel Generator	The Highway Equip. Co.	889	
olumbus	PB#1 Diesel Gen. Subcontractors	Hamilton Welding Company	18	
ortsmouth	Title III Design	Catalytic	3,459	
ortsmouth	Title III Design	Bechtel	9,395	
ortsmouth	Title III Design	Commonwealth		
ortsmouth	Title III Design	Fluor	25,000	
ortsmouth	Systems Support Contractor	SDC/DMJM	185	
andusky	Machine Assembly	Garrett	8,636	
ayton	Components	Price Bros.	95	
ayton	Components	Miscellaneous	429	

GCEP IMPACT BY CITY AND STATE

STATE OHIO

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
:leveland	Components	Miscellaneous	74	
andusky	Equipment/Facilities	Miscellaneous	5,069	
ayton	Equipment/Facilities	Miscellaneous	2,100	
oungstown	Machine Components	Commercial Shearing	97	
ayton	Machine Components	Mutual Tool & Die	100	
ipp City	Machine Components	Process Equipment Co.	106	
ipp City	Machine Components	Process Equipment Co.	63	
ima	Machine Components	Westinghouse	3,303	
kron	In-House Mach/Equip	Goodyear	11,253	
kron	Machine/Equipment	Alessio	50	
:leveland	Sas Sys	S. R. Smith Co.	1,934	
:incinnati	Fencing & Gates	William Cargile	51	
:incinnati ortsmouth	Fencing & Gates Subcontractors	Various Subcontractors(2)	144	
iketon	R/A & CTTF	Bristol Steel & Iron Works	3,600	
redericktown	R/A & CTTF Roofing & Siding	Kokosing Const. Co.	5,573	
ambridge	R/A & CTTF Roofing & Siding Subcon.	G & M Roofing and Sheet Metal	1,140	
ortsmouth	R/A & CTTF Roofing & Siding Subcon.	DOE	1,820	

GCEP IMPACT BY CITY AND STATE

STATE OHIO

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Lima Cincinnati (2) Portsmouth (2)	Transfer Corridor Shell & Steel Subcontractors	Various Subcontractors(5)	1,312	
Portsmouth	Construction Mgr./ Constructor	Stone & Webster	$0,372	
Grove City	PB#1 HVAC	Kirk Williams Co.	3,459	
Mt. Vernon Piqua Westerville Portsmouth Toledo	PB#1 HVAC Subcontr.	Various Subcontractors(5)	616	
Cleveland	PB#1 Lighting	Burks Electrical	1,145	
Cleveland	PB#1 Lighting Subcontractor	W. W. Clark	240	
Portsmouth Mt. Vernon Grove City	PB#1 Fire Prot. Subcontractor	Various Subcontractors(3)	140	
Columbus Chillicothe Portsmouth(3)	PB#1 Floor Modules Subcontractor	Various Subcontractors(5)	11,240	
Jackson	Sewage Treatment	King Contr., Inc.	2,819	
Portsmouth	Operating Contr.	Goodyear Atomic Corp.	13,458	
Fredericktown	PB#1 Shell	Kokosing	5,606	
Columbus (3) Portsmouth(2) Sahanna Hamden Hamilton	PB#1 Subcontractor	Various Subcontractors(8)	1,087	
Columbus	GCEP Administration Building	S.R. Smoot	5,990	

GCEP IMPACT BY CITY AND STATE

STATE OHIO

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Jackson Ross Springfield Avon Lake Camden Columbus (2) Cambridge Portsmouth	Sewage Treatment Subcontracts	Various Subcontractors(9)	1,331	
Fredericktown	Outside U/G Util.	Kokosing Const. Co.	13,356	
Valley City Columbus	Outside U/G Util. Subcontractors	Various Subcontractors(2	539	
Columbus	345 KV U/G Trans.	Electrical Const.	1.783	
Columbus	345 KV U/G Trans.	The W. T. Dickerson Co.		
Portsmouth (3) Minford Columbus Cincinnati	R/A & CTTF Found & U/G Subcontr.	Various Subcontractors(6)	3,277	
Columbus	Transfer Corridor Shell & Steel	S. R. Smoot Company	2,927	
Columbus	Studies	Gem City Engr. Co.	36	
Cleveland	15KV Cable Proc.	Phelps-Dodge	570	
Columbus	Lighting Sys.	J. L. Electric	43	
Akron	Building Components	Miscellaneous (13)	9,724	
Cleveland	Building Components	Miscellaneous (2)	127	
Cuyanoga Falls	Building Components	Miscellaneous (2)	335	
Avon Lake	Building Components	Spar Master	389	
Macedonia	Building Components	AFC Interior	1,304	
Magador	Building Components	Brennan Const.	147	

GCEP IMPACT BY CITY AND STATE

STATE OHIO

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
:leveland	Building/Steel	Prime Ind.	250	
:leveland	Building/Steel	American Tank	1,000	
:leveland	Building/Steel	Classified	550	
.ima	Building/Steel	Westinghouse	1,500	
\kron, Dayton, :leveland	Building/Steel	Miscellaneous	2,600	
		American Tool Works	2	
:leveland	Building Equip/Mach	George Worthington	32	
'oledo	Building Equip/Mach	Toledo	13	
\kron	Building Equip/Mach	Alessio	425	
lamilton	Building Equip/Mach	Mosler	2	
:incinnati	Building Equip/Mach	Cincinnati	1,080	
\kron	Building Equip/Mach	Standard Pressed Steel	12	
leveland	Building Equip/Mach	Warner/Swasey	271	
kron	Building Equip/Mach	Hunter	59	
roy	Building Equip/Mach	Hoist	6	
leveland	Building Equip/Mach	Miscellaneous (2)	148	
olumbus	Relocation of W/ house	B. G. Davis	1,174	
incinnati	Outside Const.Util.	Mechanicals, Inc.	276	
olumbus	Mobile Equip Garage X-751	Sherman R. Smoot, Co.	1,816	
olumbus	Gen.& Central Rec. W/house	B. G. Davis	2,969	

GCEP IMPACT BY CITY AND STATE

STATE OHIO

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Fredricktown	South Perimeter Rd & holding Pond	Kokosing Const. Co.	1,611	
Dayton	Relocation of Util.	Davis Industries, Corp.	310	
Portsmouth	RHW System Activation	Mechanical Const. Co.	13	
Columbus	PSB X-3012 Roofing & Siding	Sherman R. Smoot, Co.	904	
Jackson	P.B. X-3002 Concrete Foundation	King Contracting, Inc.	1,293	
Fredericktown	R/A & CTTF Internals	Kokosing Const. Co.	37,440	
Columbus	Central Control Bld.	Sherman R. Smoot Co.	3,040	
Fredericktown	Water Storage Tanks and Pump Stu.	Kokosing Const. Co.	4,150	
Columbus	PSB X-3010 Internals	Sherman R. Smoot Co.	5,845	
Portsmouth	Guard House Instal	Ferguson, Inc.	25	
Portsmouth	Trailer Complex	Ferguson, Inc.	26	
Fredericktown	Transfer Corridor Extension	Kokosing Const. Co.	565	
Portsmouth	R/A Storage Yard Concrete Slab	Fegruson, Inc.	2,140	
Columbus	330-13.8KV Power Transformers	McGraw - Edison Power Sys. Div.	1,429	
Cleveland	345KV Circuit Breakers	Gould-Brown Boueri	1,036	

GCEP IMPACT BY CITY AND STATE

STATE OHIO

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Cleveland	Sanitary Landfill	Gold Builders, Inc.	617	
Miamisburg	Pumping Well & Observation Wells	Moody's of Dayton	26	
Cleveland	Truck Scales & Salt Storage Bldg.	Gold Builders, Inc.	219	
Columbus	Wilhouse Mods & Storage Yards	Butt & Head, Inc.	359	
Frederick-town	Rough Grading	Kokosing Const. Co.	10,284	
Dayton	Patrol Rd. & Fencing	Davis Industries	609	
Columbus	West Perimeter Rd. & Principal Access Roads	Butt & Head, Inc.	2,654	
Columbus	Fire Station, X1007	Sherman R. Smoot Co.	1,385	
Dayton	Sanitary Water for Early Fire Protection, Phase I	Edmonds Mechanical	366	
Cleveland	Bldg. X334 Mods	Gold-Hart Builders	340	
Cincinnati	SWEC Temp. Field Admin. Bldg.	Wm. Cargile Const.	2,739	
Columbus	Foundations, U/G Utilities, Struc. Steel PSB X-3012	Sherman R. Smoot Co.	1,339	
Columbus	Temp. Const. Power & Trailer Parking Complex	J & L Elec. Co.	427	
Portsmouth	GCEP Temp. Office Facility, X-1004	Clevenger Const. Co.	115	

GCEP IMPACT BY CITY AND STATE

STATE OHIO

CITY	ITEM	CONTRACTOR, SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
leveland	Replace Switch Gear 480V	J & L Electric Co.	72	
kron	Fixtures & Slings	GAC	5	
leveland	Steel Supplier	Ryerson	500	
kron	Acoustical Test Sta.	GAC	7	
kron	Spect. Leak Detector	Goodyear	49	
	Bench Scale	Toledo	2	
kron	Tube Mfg. Mach.	GAC	1,197	
kron	Radio Drive Bal. Mach.	GAC	176	
kron	Tube Stands	GAC	2	
kron	Dollies	GAC	1	
kron	Dollies & Fixtures	GAC	4	
kron	Cycle Mach.	GAC	1	
kron	Arbors	GAC	33	
kron	Misc. Equip.	GAC	7	
kron	Ass'y. fixt.	GAC	4	
kron	Insertion Stands	GAC	62	
kron	Misc. Equip.	GAC	9	
leveland	15KV Elec. Cable	Phelps-Dodge Cable & Wire	519	
olumbus	Motor Control Centers	Westinghouse Elec. Corp.	395	
assilion	R/A Unit Sub-stations	Controlled Power Corp.	662	

GCEP IMPACT BY CITY AND STATE

STATE OHIO

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
		Airesearch	11,052	
kron	Cradles	GAC	2	
kron	Tube End Fixt's.	GAC	15	
kron	Cradles & Fixt's.	GAC	9	
kron	Dollies & Bales	GAC	4	
kron	Auto.Bal. Mod.	GAC	25	
kron	Misc. Equip.	GAC	5	
kron	Spare Parts	GAC	45	
	Micro Video-Sta.	Warner & Survey	18	
	Office Equip.	Teledyne Press	5	
kron	Engr. Spec. Equip.	GAC	10	
kron	Bridge Crane Mech.	Goodyear	10	
kron	Test Op. Equip.	Goodyear	10	
kron	Impulse Heat Dealer	Goodyear	2	
kron	Auto. Bal. Mach.	Goodyear	1,310	
kron	Office Equip.	Goodyear	5	
kron	PLTB Mfgr. Arca	Alessio	35	
kron	DIA Tank & Power Unit	Goodyear	1	
kron		Brannon Const.	200	
kron	Calibr. Equip.	GAC	58	
kron	Ass'y. Stand	GAC	11	

GCEP IMPACT BY CITY AND STATE

STATE OHIO

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
ron	Loader	GAC	45	
ron	Cut-off Mach.	GAC	90	
ron	Dollies & Slings	GAC	3	
ron	Cutting Mach. (Scrap)	GAC	43	
ron	Slings	GAC	2	
ron	Fixtures	GAC	5	
ron	Tube Remove (Air Sys.)	GAC	74	
ron	Fixtures	GAC	10	
ron	Relocate Chem Lab	GAC	21	
ron	Ring Cycle Test Equip.	GAC	147	
ron	#3 Mat'l Test. Equip.	GAC	25	
ron	Cradles & Misc. Equip.	GAC	44	
ron	Lower Susp. Equip.	GAC	38	
ron	Tools & Misc. Equip.	GAC	10	
ron	Misc. Local Supplies	GAC	1,500	
ron	Demo. GAC Shop	GAC	1	
ron	Demo. OSP Contracts	Alessio	1	
ron	All Int. Finish & Paint	GAC	1	

GCEP IMPACT BY CITY AND STATE

STATE OHIO

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
:ron	Rotor Storage Equip.	GAC	360	
:ron	Workpiece Rings	GAC	10	
:ron	Spare Parts for Carts	GAC	22	
:ron	Bales, Slings & Dollies	GAC	15	
:ron	Ring Fab. Mach.	GAC	100	
:ron	Bales & Slings	GAC	6	
:ron	#3 Mat'l Storage	GAC	5	
:ron	Racks	GAC	4	
:ron	Spare Cart Components	GAC	30	
:ron	Cut-off Mach.	GAC	35	
:ron	Slings & Dollies	GAC	3	
:ron	Lite Test Enclosure	GAC	6	
:ron	Stand & Swab Tools	GAC	3	
:ron	Spreader Bars	GAC	9	
	Material	Vendor 1	43,500	
	Material	Vendor 1	670	
	Material	Vendor 1	166	
	Hydraulic Power Unit & Cyl.	Hunt Valve Co	95	
	Rotor Clng. Eq.	United McGill Corp.	312	

GCEP IMPACT BY CITY AND STATE

STATE OHIO

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
	Material	Nat'l Lead Co.	106	
		Mutual Tool & Die	50	
		Danco Metal Prod.	.5	
		Hause Machines, Inc.	5	
		Earle M. Jorgenson Co.	53	
		United Air Spec.	1	
		Palmer Supply Co.	1	
		Bendix, Auto.	1	
ortsmouth	Operations Plant	Goodyear Atomic	2,900	
ortsmouth	Misc. Contracts	Boeing Corp.	1,550	
incinnati	PB-1 Roof Drains & Sewers	W.M. Cargile Constructors	114	
ackson	PB-2 VG/Util/Found	King Const., Inc.	1,320	
ayton	Paving Roads	W.C. Jones	474	
leveland	Painting SWT/YDS	Gold Builders	368	

GCEP IMPACT BY CITY AND STATE

STATE OHIO

CITY	ITEM	CONTRACTOR/ SUBCONTRACTOR	CONTRACT VALUE (x$1000)	REMARKS
Decatur	Service Modules	Teledyne-Brown	15,919	
Cincinnati	345 KV Pipe Cable System	Okonite Co.	1,441	

Senator DOMENICI. Thank you very much. We will now go with Dr. Hartig, vice president of Goodyear Aerospace Corp. We welcome you.

STATEMENT OF DR. E. O. HARTIG, VICE PRESIDENT, GOODYEAR AEROSPACE CORP.

Dr. HARTIG. Mr. Chairman, members of the committee, I am E. O. Hartig, vice president of Goodyear Aerospace Corp. We are a wholly owned subsidiary of the Goodyear Tire & Rubber Co. Our corporation manufactures centrifuges for the GCEP program and in addition we are involved in the development—our corporation manufactures centrifuges for the GCEP program and we are involved also in development of the gas centrifuge.

We appreciate the opportunity to share with the committee our thoughts and concerns about uranium enrichment. Mr. Chairman, in the interest of time, I will present excerpts from my written statement and request that the whole text be included in the recorded of the hearing.

Senator DOMENICI. It will be made a part of the record and we appreciate your assistance in making your remarks brief.

Dr. HARTIG. Goodyear Aerospace has been engaged in the development and production of enrichment equipment since 1972. We feel qualified to comment on DOE's enrichment program and to express our opinions on the GCEP program and the need for its continuity.

We feel strongly that the United States must maintain a position of world leadership in nuclear technology and be a reliable supplier of enrichment services if we are to exert a positive influence on the free world in nuclear energy affairs.

The United States has experienced a decline in foreign sales of enrichment services from a 100-percent marketshare in 1974 to 35 percent today. This loss of market has injured our balance of trade and has reduced our nuclear influence worldwide.

This erosion can only be stopped by continuing our efforts to remain competitive. Competitiveness in the marketplace means the ability to deliver a product which is competitive with foreign suppliers. It also depends on the buyer's belief that the United States is a reliable source.

Using present gaseous diffusion enrichment facilities the United States is gradually losing the ability to sell at a competitive price.

Gas centrifuge is the only here and now technology that can stabilize or reduce the price of separative work sold by the Department of Energy. The cost of separative work from GCEP will be significantly lower than from the existing gaseous diffusion plants which require large quantities of electricity.

Now, only the first two process buildings of GCEP are now authorized. We believe careful cost analysis will show that the completion of all eight process buildings will be desirable and cost effective. With certain common facilities in place, the cost of separative work produced in the later buildings will be significantly lower.

The attractive economics will leave no other reasonable choice than to complete all of the eight process buildings.

As a developer and manufacturer we can say with confidence that the centrifuge technology has proven that the projected costs are realistic. Initial deliveries of production units have met or exceeded all performance objectives.

Goodyear Aerospace has invested over $50 million of its own funds in centrifuge technology and dedicated manufacturing facilities. The other two centrifuge manufacturers, as you have heard, have also made significant investments. It is essential that consideration be given to a reasonable return of this invested private capital.

The Government made certain representations early in the GCEP program upon which industry based its investment decisions. Further slowdown or stretchout of GCEP schedules will jeopardize those returns and make it difficult to justify and obtain the added capital investments required for phase II production.

The industrial centrifuge production base requested by DOE has been established in the training of new employees on schedule. More than 200 new employees will be added at Goodyear Aerospace alone in 1982. About 1,000 people are directly employed at the Portsmouth plant construction site, plus many more offsite jobs in 41 States.

This program must continue without interruption if the potential cost benefits are to be achieved. Any delay in the program will substantially increase the program's cost, not only by inflation, but also by manufacturing and construction inefficiencies and by delaying the partial retirement of the energy intensive gaseous diffusion facilities.

Further delays also will erode the industrial base which has been established for centrifuge manufacturing.

As you know, the enrichment program is self-sustaining. Revenues received in return for enrichment services are applied to offset expenditures and they equal or exceed the projected fiscal 1983 budget. Full cost recovery accounting is used, but no profit is added. This includes items such as depreciation, interest, and cost for further improving centrifuge technology and for advanced isotope separation techniques.

It is important that this business practice be maintained since we believe it would penalize the utility ratepayer if revenues were diverted for other purposes. The U.S. enrichment program has contributed over $9 billion in revenue. Much of the revenue is from overseas customers and is a significant benefit to our balance of trade.

Each new reactor added to the DOE order book adds approximately $400 million in revenues over the life of the reactor.

The development of advanced centrifuges is proceeding very satisfactorily. DOE forecasts a step-by-step improvement in machine performance over the present baseline production design. The near-term goal is 50 percent output improvement by 1988 and a longer term goal of 100 percent by the mid-1990's.

We see no reason to question these projections. A 22-percent performance improvement has already been achieved in machines now running in Goodyear's test facilities. Equipment that will provide further performance improvement is being ready for tests. We feel strongly that uranium enrichment utilizing advanced centrifuge

technology will be competitive with any other enrichment process being proposed.

Let me also comment briefly on the competitive technologies being developed. New processes are being developed and the existing technologies are being further refined by the DOE's competitors, France, Japan, and in the German/Dutch/English consortium, Urenco. These technologies will be exploited and used unless it is clear that they will not be competitive with U.S. enrichment operations.

Advanced isotope separation technologies also are being developed and promoted within the United States. We support the development of these new technologies. I would caution, however, that the new laser and plasma technologies should not be oversold. They must be developed in a sound and methodical manner so that true costs can be established before we abandon more proven processes.

We believe it will be the last half of the 1990's before the AIS technologies perform into the true production capability. U.S. centrifuge technology is the most advanced and cost effective enrichment technology available in the world today. We must exploit this advantage if the Untied States is to maintain its position of leadership as a supplier of nuclear fuel.

Goodyear believes DOE's GCEP budget requests for fiscal 1983 are based on sound judgments and we urge your committee to support this activity at the level requested.

Thank you.

[The prepared statement of Dr. Hartig follows:]

GOODYEAR
GOODYEAR AEROSPACE CORPORATION
1210 Massillon Road, Akron, Ohio 44315
Public Relations (216) 796-3632

STATEMENT

DR. E. O. HARTIG

VICE PRESIDENT, GOODYEAR AEROSPACE CORPORATION

SUBSIDIARY OF

THE GOODYEAR TIRE & RUBBER COMPANY

THE SUBCOMMITTEE ON ENERGY RESEARCH & DEVELOPMENT

UNITED STATES SENATE

JUNE 24, 1982

Mr. Chairman, I am E. O. Hartig, Vice President of Goodyear Aerospace Corporation, a wholly-owned subsidiary of The Goodyear Tire & Rubber Company. Our corporation manufactures centrifuges for the Department of Energy's Gas Centrifuge Enrichment Program (GCEP).

We appreciate the opportunity to share with the Committee our thoughts and concerns about nuclear power.

Goodyear Aerospace is a strong supporter of nuclear power. We feel that nuclear power is urgently needed to provide a safe, economical, environmentally clean source of electrical energy -- energy needed for the expansion of our economy and needed to lessen the United States' dependence on imported oil.

Goodyear Aerospace has been actively engaged in the development and production of enrichment equipment since 1972. We feel qualified to comment on industry's perception of the DOE enrichment program, and to express our opinions on the GCEP program and the need for its continuity.

Our concerns relate to possible budget cuts in DOE's enrichment program resulting in a deterioration of GCEP schedules and costs, and the U.S. position of leadership in the world marketplace.

(more)

Unless the GCEP program proceeds on schedule, the competitive position of DOE's enrichment program will be seriously degraded. We feel strongly that the U.S. must maintain a position of world leadership in nuclear technology and be a reliable supplier of enrichment services if we are to positively influence the use of nuclear energy in the free world.

This position of leadership also is necessary if the U.S. is to exercise a positive influence for non-proliferation. We must be ready to assist nations without great energy resources. We must continue to be a reliable and cost-competitive supplier of enriched uranium to countries that want to develop a nuclear energy capability. If we can help them find low-cost energy, we reduce the risk they will develop difficult-to-monitor enrichment capabilities -- with the attendant risk of diversion of enriched materials for military purposes.

To project the image -- and substance -- of a reliable supplier, the on-again, off-again U.S. supply posture must end. We must continue a steady course, without further delay in the GCEP construction schedule, to continue to exert leadership and be competitive in world markets. Continued and reliable material supplies are vital to any business venture, particularly to a capital-intensive venture such as a utility. A predictable supply of enriched material is of special concern to our overseas customers.

We must take advantage of centrifuge technology to stabilize prices and to retain current and future markets. You have heard

or read in previous testimony by DOE officials that the U.S. share of the foreign free world nuclear fuel market has deteriorated from 100 percent in the mid '70s to 35 percent in 1981. This loss of market has injured our balance of trade and has reduced our nuclear influence worldwide. This erosion can only be stopped by continuing our efforts to remain competitive. Competitiveness in the marketplace means the ability to deliver a product which is competitive with foreign suppliers. It also depends on the purchaser's belief that the seller is a reliable source. Using present enrichment facilities, the U.S. is gradually losing the ability to sell at a competitive price. We must regain that ability, but it also is important that we remain a reliable and predictable supplier.

It is important that we use the most cost effective technologies to service our customers. Currently, DOE uses gaseous diffusion to enrich nuclear fuels. This process is energy-intensive and wasteful. With the rapid rise in electric fuel costs -- at a pace faster than the general inflation rate -- the cost of producing separative work is rapidly escalating.

The use of the gas centrifuge technology, a technology well developed and currently being readied for production in the Portsmouth gas centrifuge enrichment plant, is the only here-and-now technology that can stabilize or reduce the price of separative work sold by the DOE.

The U.S. has made substantial progress in the establishment of gas centrifuge enrichment and has consistently improved machine performance and reliability. GCEP will take advantage of the energy

conservation the centrifuge process provides, and the cost reductions it permits in the enrichment of uranium. The failure to take advantage of the savings possible through the centrifuge enrichment process will only weaken our competitive position and result in further loss of market share -- a loss that history has shown will be difficult to reverse.

Only the first two process buildings of the GCEP plant are now authorized. We believe careful cost analyses will show that the completion of all eight process buildings envisioned in the total GCEP plan will be desirable and cost-effective. With certain common facilities in place, the cost of separative work units produced in the latter buildings will be significantly reduced. The attractive economics of the situation will leave no other reasonable choice than to complete all eight buildings.

By lowering the composite selling price of U.S. separative work, the full GCEP plant production will keep the U.S. competitive in the enrichment marketplace. Delays to the projected schedule can only increase costs and reduce the effectiveness of DOE efforts to solicit new enrichment contracts, particularly from customers overseas.

As a developer and manufacturer, we can say with confidence that the centrifuge technology is proven and that the projected costs are realistic. Initial deliveries of production units have been made and testing has gone well, with all of the performance objectives being met or exceeded.

(more)

Goodyear Aerospace has invested over $50 million of its own funds in centrifuge development activities and for dedicated manufacturing facilities. The other two centrifuge manufacturers have also made significant investments. It is essential that consideration be given to the reasonable return on this invested private capital. The government made certain representations early in the GCEP program upon which industry based its investment decisions. Further slowdowns or stretch-outs of GCEP schedules will jeopardize those returns and make it difficult to justify and obtain the added capital investments required for Phase II production.

The industrial centrifuge production base requested by DOE has been established, and the training of new employees is on schedule, with excellent results. More than 200 new employees will be added at Goodyear Aerospace alone in 1982. About one thousand (1,000) people are directly employed at the Portsmouth plant construction site, plus many more jobs created by the off-site manufacturing in progress in 41 states.

This program must continue without interruption if the potential cost benefits are to be achieved. Any delay in the program will substantially increase the program's costs, not only by inflation, but also by manufacturing and construction inefficiencies, and by delaying the partial retirement of the energy intensive gaseous diffusion facilities. In addition, further delays will erode the industrial base which has been established for centrifuge technology.

As you know, the enrichment program is self-sustaining. Revenues now received in return for enrichment services are applied

to offset expenditures, and they equal or exceed the projected FY-83 budget. Full cost recovery accounting is used and includes items such as depreciation, interest, and costs for further improving centrifuge technology, and for advance isotope separation techniques. It is important that this business practice be maintained since we believe it would penalize the utility rate-payer if revenues were diverted for other purposes.

The U.S. enrichment program has contributed over $9 billion in revenue. Much of the revenue is from overseas customers and is a significant benefit to our balance of trade. Each new reactor added to the DOE order book adds approximately $400 million in revenues over the life of the reactor contract.

The development of advanced centrifuges has proceeded in a highly satisfactory fashion over the past year. DOE forecasts a step-by-step improvement in machine performance over the present baseline production design. The near-term goal is 50 percent output improvement by 1988, and a longer term goal of 100 percent by the mid 90's. We see no reason today to question these projections. A 22 percent performance improvement has already been achieved in machines now running in Goodyear's test facilities. Tests are proceeding on equipment which we feel will provide further performance improvements. We feel strongly that uranium enrichment utilizing advanced centrifuge technology will be competitive with any other enrichment process being proposed.

Let me also comment briefly on the competitive technologies being developed. First, while we are not able to determine exact details, it is fact that new processes are being developed and that existing technologies are being further refined by the DOE's

competitors, France, Japan, and in the German/Dutch/English consortium (URENCO). These technologies will be exploited and used unless it is clear that they will not be competitive with U.S. enrichment operations.

Advanced isotope separation technologies also are being developed and promoted within the U.S. We support the development of these new technologies. I would caution, however, that the new laser and plasma technologies should not be oversold. They must be developed in a sound and methodical manner so that true costs can be established before we abandon more proven processes.

As the Vice President of a high-technology company, I have seen numerous situations over the years where new ideas were over-promoted and where decisions were based on hoped-for projections rather than on proven results. The result is a familiar story -- behind-schedule positions, cost overruns, and lost production. The enthusiasm of the new developer must be tempered with the lessons of experience so that we proceed on a steady and predictable program.

U.S. centrifuge technology is the most advanced and cost effective enrichment technology available in the world today. We must exploit this advantage if the U.S. is to maintain its position of leadership as a supplier of nuclear fuel.

We appreciate the opportunity to express our thoughts and observations on DOE's enrichment program. Goodyear believes DOE's uranium enrichment budget requests for FY-83 are based on sound judgments, and we urge your Committee to support this activity at the level requested.

-0-

Attachment 1

THE U.S. GAS CENTRIFUGE DEVELOPMENT PROGRAM

The U.S. gas centrifuge enrichment program is the result of over 20 years of research, beginning with the initiation of experimental work at Union Carbide Corporation's Nuclear Division at Oak Ridge, Tennessee in 1960 and at AiResearch Manufacturing Company at Torrance, California in 1961. This work built upon earlier research, such as the first demonstration of an operating gas centrifuge by Dr. Jesse W. Beams of the University of Virginia in 1934.

Progress has been impressive since the first cascade of 35 centrifuges was operated successfully at Oak Ridge in 1961, demonstrating technical feasibility. A subsequent demonstration cascade, the Component Test Facility (CTF), was operated with production-scale centrifuges from both Union Carbide and AiResearch and proved the long-term reliability of large centrifuges typical of the modern generation machines. The CTF also demonstrated the ability to produce approximately 50,000 separative work units of enrichment per year with a modest number of centrifuges.

Since the initial research began, the unit capacity of individual centrifuges has increased several orders of magnitude over early centrifuges. Total operating experience has been substantial. Centrifuges of successive models have accumulated a grand total of over 2,000 machine-years using uranium hexafluoride process gas.

The baseline centrifuge is established for the Gas Centrifuge Enrichment Plant (GCEP) and is being manufactured by three commercial firms -- Boeing Engineering and Construction, Goodyear Aerospace Corporation, and the Garrett Corporation. This centrifuge, designed Set III, is undergoing reliability testing in the Advanced Equipment Test Facility (AETF). Operating experience with the Set III centrifuge is already extensive. Through May 1982, Set III centrifuges have operated over 104 machine-years on uranium hexafluoride.

Substantial numbers of Set III centrifuges will operate in the Centrifuge Plant Demonstration Facility (CPDF), which is scheduled for startup in late 1982. The CPDF will verify the cascade operability of centrifuges produced by the three commercial suppliers. These suppliers have invested private funds totaling about $100 million in manufacturing facilities and equipment necessary to produce the GCEP centrifuge.

The current production contract will provide centrifuges for the CPDF and a portion of the initial fill for GCEP. At the end of May 1982, hardware for 74% of the CPDF machines had been delivered by the three manufacturers. At that time, 66% of the machines were assembled and 46% were installed in the CPDF and in the Centrifuge Verification Test Facility prior to being installed in the CPDF. The pace of installation is increasing and full operation of CPDF is expected to be on schedule.

The technology of the gas centrifuge is fully proven as the result of over 20 years of research. Performance of the centrifuge has been confirmed and its reliability has been established through detailed evaluation of current and preceding centrifuge models. The reliability testing of the baseline centrifuge has shown excellent performance. This centrifuge is now in full-scale commercial production by three qualified manufacturers and will be ready for installation in GCEP on schedule.

Attachment 1

TABLE 1

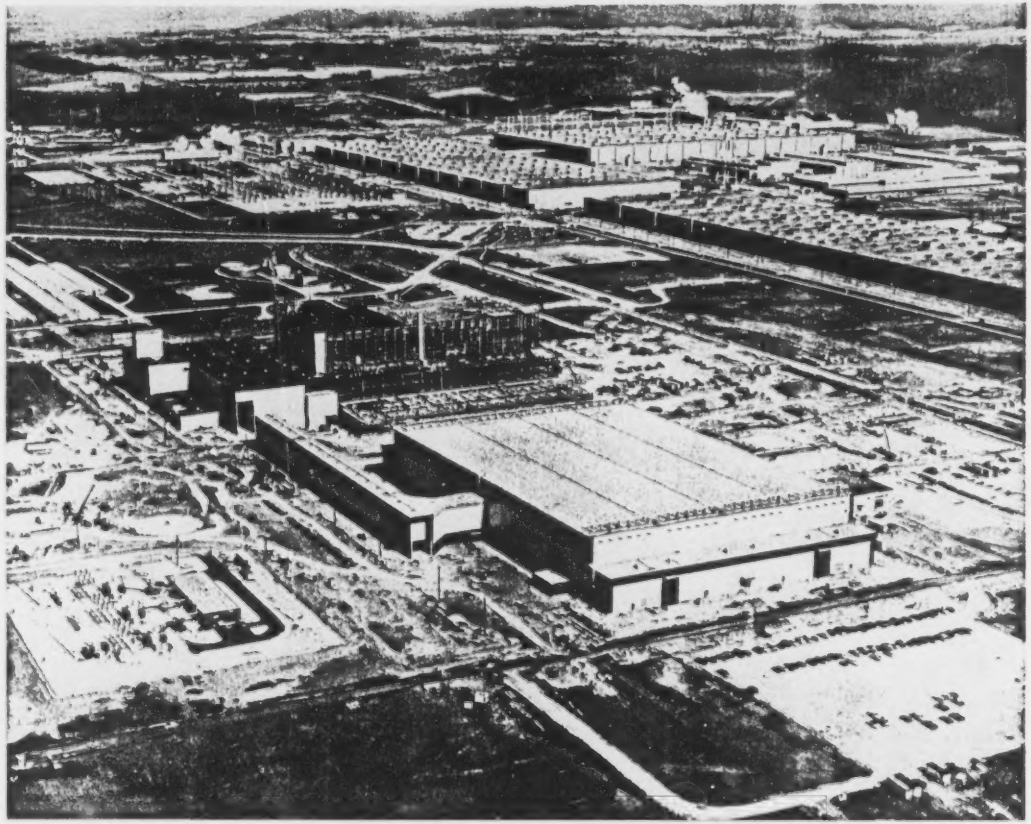
CENTRIFUGE OPERATING EXPERIENCE*

		Machine-Years On Gas
1.	Set I Reliability Testing	496
2.	Set II Screening & Reliability Testing	172
3.	Set II Cascade Testing**	
	Group 5	544
	Group 6	660
	TOTAL	1204
4.	Set III (GCEP) Screening & Reliability Testing	104
5.	Set III Production Testing	9
6.	Set III Cascade Testing in CPDF	***

* Experience on modern GCEP prototypical centrifuges.

** The annual capacity of this pilot plant was 50,000 separative work units.

*** This facility will begin operation in October 1982.



GAS CENTRIFUGE ENRICHMENT PLANT
PORTSMOUTH, OHIO

Senator DOMENICI. Thank you, Dr. Hartig.

Let me make a couple of announcements. The American Nuclear Council and Edison Electric Institute will be submitting testimony for the record and we will incorporate that into the record. I assume they will do that rather soon.

[The statement follows:]

STATEMENT OF
EDISON ELECTRIC INSTITUTE
AND
AMERICAN NUCLEAR ENERGY COUNCIL

ON

URANIUM ENRICHMENT PROGRAM

SUBMITTED TO
SUBCOMMITTEE ON ENERGY RESEARCH AND DEVELOPMENT
COMMITTEE ON ENERGY AND NATURAL RESOURCES
UNITED STATES SENATE

JUNE 24, 1982

The Edison Electric Institute and the American Nuclear Energy Council are pleased to have the opportunity to submit this statement on uranium enrichment and in support of the Portsmouth Gas Centrifuge Enrichment Plant (GCEP), which is currently under construction at Piketon, Ohio. The Edison Electric Institute is the association of investor-owned electric utilities. Its members provide about 78 percent of the nation's electricity serving over 67 million customers and include most of the Department of Energy's domestic enrichment customers. The American Nuclear Energy Council represents more than 100 organizations in the nuclear power industry, including utilities, manufacturers and fuel suppliers.

The members of the Institute and the Council generally support President Reagan's overall economic program and the DoE nuclear budget request for FY 1983, including those funds requested for enrichment activities, in general, and the GCEP project, specifically. It cannot be emphasized enough that in FY 1983, and presumably beyond, all of the DoE enrichment outlays, including GCEP, are more than offset by the enrichment revenues paid by domestic utilities and foreign customers. The DoE FY 1983 enrichment budget request calls for a zero net appropriation and a projected $66 million carry over to FY 1984. We support this budget element.

Uranium enrichment is an essential step in the process of providing fuel for the Nation's and the world's commercial nuclear power programs. The

Federal Government has retained the enrichment step within its jurisdiction as a secret process with national security implications. Fees are paid for this service by domestic utilities and foreign customers on the basis of achieving full cost recovery over a reasonable period of time. Thus, the Federal Government is being reimbursed fully for its total cost, including the write-off of facilities that were originally constructed for military purposes. The fees collected are payment for services rendered and are not tax revenues. Enrichment service revenues should not be used for other purposes.

A primary goal for the Nation's energy future should be the early replacement of our demand on the depleting world reserve of petroleum, wherever practical, with the use of our abundant domestic solid fuels - coal and uranium. The best and earliest means of increasing the use of domestic solid fuels is through the increased use of electricity generated by coal and nuclear power plants. Every industry and Federal Government projection of the future energy mix includes a substantial increase in the electricity component. In recognition, the timely development and growth of civilian nuclear power programs have received bipartisan support. President Reagan, following the recent Economic Conference at Versailles, jointly issued an energy statement with six other major industrial nations that affirmed the need "...to promote alternative (energy) sources, including nuclear energy and coal...". President Carter, at the close of the July 1978 Bonn Economic Summit, signed a declaration stating, "The further development of nuclear energy is indispensable and the slippage in execution of nuclear power programs must be reversed". Actions by the Federal Government should reflect this need and sound uranium enrichment service is an important element of providing a reliable supply of economical electricity.

While conservation through greater efficiency in the use of energy must be encouraged and the search of economic alternative fuels be pursued with vigor, we must proceed to improve the use of those technologies that are available and develop those on which we have a high confidence of achieving success. In fact, the gas centrifuge uranium enrichment process to be installed in GCEP will use less than five percent of the electricity used

by the currently employed gaseous diffusion uranium enrichment process. This is a primary example of energy conservation brought about by rising energy costs.

Within the planning horizon of the utility industry, a high confidence path is followed by increasing the use of coal and nuclear fission. Both coal and nuclear fission must be used to achieve the desired high degree of overall reliability for the electricity supply system as we build new plants to serve the growing economy, displace the use of petroleum and replace obsolete facilities.

Presently, some 12 percent of our total national output of electricity comes from nuclear energy. Today nuclear generating capacity, some 56,000 MWe, exceeds the entire installed electric capacity as it existed in this country just 35 years ago. In addition to the 78 operating nuclear plants, some 70 additional facilities have construction permits from the NRC. When completed, these will add over 70,000 MWe of generating capacity, which will result in generation from nuclear of about 25 percent of the national total. Nuclear power is already providing over 50 percent of the electricity in some areas of the country.

In order to obtain the enriched uranium that is necessary for the operation of these nuclear power plants, electric utilities hold contracts with the Department of Energy for uranium enrichment services. DoE has about 300 long-term contracts for enrichment services (about half with domestic utilities) many of which do not expire until well after the year 2000. Based on current enrichment costs, these contracts are valued at over $80 billion. As specified in the Atomic Energy Act and Congressionally approved enrichment pricing cirteria, the DoE calculates its charge for uranium enrichment on the basis of recovering the Government's full cost over a reasonable period of time.

We would like to take this opportunity to comment on two recently released reports on the GCEP project: one by the General Accounting Office (GAO) and one by the Congressional Research Service (CRS). We have reviewed these reports and find that they do not sway us from our support of GCEP.

The GAO and CRS reports properly point out that GCEP was originally justified by the projections of high nuclear power growth and demand for enrichment services. But now that the projected demand has been reduced due to the well known problems of the electric utility industry and the economy in general, the justification for GCEP lies in its economics. The GAO report further addresses the economics of GCEP in light of the new, lower demand projections and concludes, based on a patently inappropriate inference of the absolute success of a commercialized Advanced Isotope Separation (AIS) process in 1995, that GCEP is uneconomical and cautions Congress to consider carefully decisions to fund GCEP.

We reject the GAO inference that AIS technology is a commercial certainty in 1995. The GCEP technology already exists and we are confident that it can be in commercial operation by 1989 provided there is sufficient funding. In our opinion, GCEP is needed for assurance of enrichment cost containment because its introduction will start limiting the otherwise unending rise of the separative work unit price, which will result from the energy intensive nature of the gaseous diffusion process and rising energy costs. As pointed out above, the GCEP process uses less than five percent of the energy required by the gaseous diffusion process. While we concur with GAO in their current estimate of the future growth of nuclear power as far as it goes, we reject the implied premise that the growth projections must necessarily remain low as the Nation begins to move away from the current era of reduced economic activity.

Electric Growth Projections

The future of electric growth is directly related to the future of the Nation's economy. By current measurements, the Administration appears to be enacting policies that will control inflation and bring down interest rates. We are hopeful that these changes will allow the long term economic improvement that the Nation needs. Along with that economic growth will be growth in the demand for electricity, which we believe will rekindle the growth of nuclear power.

In 1981 EEI released its study of the Nation's economic growth in the future. Choice Over Chance (Preager Press), which points to a preferred scenario that includes certain economic changes that spur the economy.

This economic growth in turn necessitates a nuclear generating capacity in this country of 300 GWe by the year 2000. We acknowledge that there are many other changes that must be made before the projected use of nuclear power will increase, including improvement in the financial condition of the electric utility industry and a revision to the way nuclear power plants are licensed. However, we are working with Congress, the Administration, the Nuclear Regulatory Commission and local public utility commissions to achieve the needed changes, and we want to assure that a lack of an economically sound enrichment program will not stand in the way of the necessary choices for the growth of nuclear power, which will be needed for the growth of the economy.

Enrichment Service Demand

The GAO and CRS enrichment demand projections fail to analyze the effects of decisions resulting from their implied recommendations and therefore fail to see the self-fulfilling prophecy nature of these projections. If DoE is prevented from completing GCEP, a very direct signal will be sent to all DoE enrichment customers that the United States is not interested in containing enrichment service costs. This will most assuredly drive away the foreign customers as well as make the domestic customers seriously consider contracting with foreign enrichers. This will not be a healthy situation. Due to the nature of the DoE enrichment service pricing structure (i.e., full cost recovery over a resonable period of time), a reduction in future enrichment demand causes the separative work unit (SWU) price to rise for as many as ten years before the reduced demand actually occurs. The rising DoE SWU price will also allow world-wide enrichment prices to rise. These increased enrichment costs will increase the cost of producing electricity from existing nuclear plants and serve, as stated above, to help preclude choices allowing for growth in nuclear power.

The GAO report concludes, based upon four-year old GAO work, that foreign customers will be driven away in any event by non-proliferation concerns. However, in May 26, 1982 testimony before the House Appropriations Committee Energy and Water Development Subcommittee, DoE Assistant Secretary Brewer pointed out that recent information concerning the attitudes of the foreign customers indicates that their primary concern is

for cost containment. In addition, the CRS report indicates a belief that driving this business away is acceptable because of all the possible foreign enrichment capacity. Why should the United States, through a decision not to complete GCEP thereby failing to contain enrichment service costs, turn those possibilities into realities and fulfill the prophecy of the GAO and CRS projections?

Economics of Enrichment Strategies

The GAO report relies heavily on the DoE 1980 Enrichment Strategy Study as the baseline for comparing the economics of the various enrichment technologies in combination over time. The GAO report concludes that the strategy of the currently employed gaseous diffusion plant (GDP) followed by AIS in 1995 is more economical than GDP followed by GCEP in 1988, then followed by AIS in 1995. We would agree if it were not for one major flaw in the analysis: the unquestioning acceptance by GAO that AIS will be commercially successful in 1995. We suspect that DoE might also agree with GAO if not for that basic and overbearing flaw. Dr. Brewer's May 26th statement addresses this point at length.

The AIS technology is classified, but from what we know about its status of development versus that of centrifuge technology, we find it difficult to believe that any reasonable engineering judgment would place AIS on an equal footing with GCEP as a commercial reality. GAO does this by assuming that AIS will be successfully commercialized in 1995 while, at the same time, penalizing GCEP for uncertainties.

Again, the GAO report fails to recognize the effect of decisions resulting from its projections. If GCEP is cancelled in favor of AIS and AIS fails, clearly the wrong decision has been made; but things are rarely so clear cut and GAO has failed to recognize the vagaries of the situation. If GCEP is cancelled - allowing for the moment GAO's unreasonable inference about the 1995 AIS commercial success - a minimum of seven years will be added to the time from today before enrichment costs begin to be contained due solely to the AIS 1995 commercial date versus the GCEP 1988 commercial date. These additional seven years will subject the AIS technology to greater political and funding uncertainties as compared with GCEP. When adding the technological uncertainties of AIS to these additional political

and funding uncertainties, any assurance that AIS will be available in 1995 to begin containing enrichment costs is, in our opinion, questionable.

The GAO report questions the DoE projected electricity cost growth rate for the enrichment plants - a crucial factor in the economic analysis. DoE, based on their years of experience in contracting for and purchasing electric power for the enrichment complex, used three percent above general inflation through 1990 and 1.5 percent thereafter. GAO recommends, based on the Energy Information Administration 1981 annual report, 0.4 percent above general inflation through 1990 and at inflation thereafter. Dr. Brewer's May 26th statement suggests that GAO used the EIA report incorrectly. It should be very easy to straighten out that controversy and we assume DoE will obtain the necessary input from EIA. However, we offer the following guidance for assessing the growth of electric costs for highly specific applications. In 1980, the DoE enrichment complex used 24,488 million kilowatt hours of electricity. In the same year twenty-one states each consumed less electricity. The sheer amount of electricity used by the DoE enrichment complex indicates that the projection of future costs cannot simply be limited to the projected, aggregated growth of electricity costs in the economy, but must include the experience of the application. The concepts of rate classes, cross-subsidization and special service contracts tend to deviate costs for large commercial applications, and especially the DoE power contracts for the enrichment complex, from projected, aggregated norms. This leads us to believe that the DoE experienced-based estimate is more believable than the GAO estimate.

There are other items in the GAO review of the DoE economic analysis that we question, such as GAO's criticism of minor parameters in the DoE model that have little relative effect on the decision.

In conclusion, we recommend that Congress continue to support the construction of GCEP. As mentioned earlier, the GCEP project is fully funded by enrichment revenues and, therefore, by the electric utility ratepayer, both domestic and foreign. Considering the electric utility industry's fiduciary responsibility for the ratepayer's money, we believe

proceeding with GCEP is the proper, prudent decision given the uncertainties in AIS technology and the need for enrichment cost containment.

The Edison Electric Institute and the American Nuclear Energy Council stand ready to assist the Subcommittee and Congress in further reviewing the GCEP funding question and enrichment in general.

Senator DOMENICI. Our leader, Senator Baker, has some questions for the record. I will submit them. One of the questions—the others you can answer and submit for the record, but Mr. Grant on behalf of Senator Baker, let me ask you this question as he has written it.

It reads as follows:

> Let us see if we can reduce the complicated air-prone analysis of GCEP economics to some simple proportions. Suppose GCEP is completed, that it simply displaces 8.8 SWU's of existing diffusion capacity that would then be unused. Suppose further that the electricity cost escalation does not exceed inflation. How long would it take for GCEP to pay for the original $7 billion capital investment cost?

That is at what time would electricity cost savings alone equal cost of building GCEP?

Mr. GRANT. Ten years, 10.2, I believe, is the precise answer to that question.

Senator DOMENICI. All right. One big assumption of that is the electricity cost escalation does not exceed inflation, of course. But it does make it rather understandable. Now, there are two others that we will submit for Senator Baker and any others that he might have.

Do any of the other Senators have any questions? The minority Senators will have questions for the record and if you answer them as rapidly as you can it will be appreciated.

Senator McClure will submit some and you can answer those also as soon as it is practical.

Let me ask you, all of these models and assumptions make things rather difficult to understand, but let me see if I can just ask you a rather simple question. If we are going to be in the uranium business, that is if we are going to have a nuclear industry, the cost of operating the existing facility is, as I understand it, escalating rapidly.

That could put that enrichment process in a position where it would become extremely expensive vis-a-vis other competitors in the world and extremely costly for domestic users who might use it and some judgment has to be applied as to whether or not this major capital improvement program will make that situation better or not, the situation you just described.

Is that a fair assessment of a complicated situation?

Mr. GRANT. Senator, it would appear to me. I am not sure I totally understand. But to put it in my kind of terms, I do not know how the future is going to behave and what is going to happen to inflation and how such electricity costs are going to escalate over that.

We certainly have about 10 years of experience, which is devastating experience in terms of what enrichment by the diffusion process is costing us today.

Just to cite some examples, I suppose, electricity in 1981 cost DOE about 3 cents a killowatt hour. In 1982 it is a little more than that 3 cents. To cite an example if the centrifuge plant were on line today with one SWU of enriched product out of the diffusion plant with power and labor costs, and we will not complicate it with costs of money things for a moment, it would cost a $100 of SWU today, with those two elements of cost.

Centrifuge, on the other hand, would cost $32 of SWU. Now, that gives you $68 to play with. Now, you can become your own private economist with your little home computers now and take that $68 and decide how you are going to spend it or multiply it by the number of SWU's you think will be built over a certain period of time and play games with your check book. Your balance will look great. That is the kind of game you are playing.

One other thing, I buy my electricty from TVA just like DOE does at my plant at Oak Ridge as well as at my home in Oak Ridge. At my plant in Oak Ridge I pay a nickel for what DOE pays 3 cents a little bit for. At home I pay 4½ cents. I get a break at home, because I don't use as much as I do at my plant.

If that were the case, if DOE were paying that price for it in 1982 dollars, the electricity cost for 8.8 million SWU's of centrifuge would be about $50 million for 8.8 million SWU's of diffusion or put another way $5.70 for centrifuge SWU compared to $112.50 for diffusion SWU.

I don't know whether I have answered anybody's question, but that is the kind of economic swings we are talking about.

Senator DOMENICI. I guess I will put it another way, if what I said a minute ago did not make sense to you. I think what we have to do if we are seriously interested in opening up this issue and I don't know if you ought to construe this hearing to be that, we have a GAO report that indicates some things that prompted an oversight hearing and that is what it is about, but it seems to me that we have a situation where the Government is doing something that is much like what the private sector does in many other aspects of our industrial base, but this one happens to be the Government.

So DOE is kind of the corporation here. Yet, it is our government and we have government responsibility. If an American domestic corporation had enough resources to be investing in this, I think the bottom line is that if they looked at everytning in the world and all of the economics you have described and those of GAO, would they invest this kind of money and say it is something that is needed to stay in this field?

And I think you all, you cannot answer it with the same kind of issue, because you are not going to have to do that and you have a pecuniary interest the other way basiclly that we keep it going. But I gather that as businessmen you are telling us here that it is really a good business deal for the United States of America, if I read you right.

Mr. ROWAN. Right. Not only good but necessary, Senator Domenici, for the survival of enterprise. Without it it is just as Dick Grant said earlier, we will price ourselves out of the business, the country will, if GCEP is not put into place.

Dr. HARTIG. You are talking about losing a lot of foreign market, but let me point out another thing, if we are not competitive, if the U.S. utilities can buy their enriched fuel from foreign sources at a lower price, we will see the same situation that we see in the steel industry and the automobile industry.

Mr. ROWAN. And that has actually occurred. Rochester Gas & Electric is one of the first buyers of foreign SWU service.

Senator DOMENICI. Who are they buying it from?

Mr. ROWAN. Coming from Russia, directly. But the errosion possibility is there, I guess is what we are telling you and it will increase as the price differential between competitor SWU supply and U.S. SWU supply also increases. That margin grows greater. We must be competitive in the United States.

Senator DOMENICI. You heard me talk to the Secretary about us making a national policy decision with reference to selling our technology in this area to other countries. But what do each of you think about that? Do we discourage that or do we encourage it or how does that affect what you are saying is imperative if we remain competitive?

Mr. GRANT. Let me first of all disqualify myself in that regard, because we chose not to make an offering to the Australians in that particular case.

Mr. ROWAN. The Garrett Corp. did. We were quite prominent there in the initial efforts of the Australian trade. Let me see if I can answer it. It is a complicated question because it requires the consideration of a whole array of complicated issues, many of which were touched upon by Senator McClure when he was here earlier.

We get one kind of an answer back when we deal with the issue and the total nuclear fuel cycle aspect of it, when you look at all aspects of it. We at Garrett are not in the total nuclear fuel cycle. We are in one part of the enrichment and some related reactor valve components that we supply.

So I would have to confine my answer to you in terms of the enrichment enterprise and I would have to give you a businessman's answer on it, Senator Domenici, and that is we are governed by government policy in this area on it. If the Government decides that is what they are going to do as we pursue our business we have to pursue it in the marketplace wherever that marketplace appears and it is administration policy and nothing of private industry doing that created the condition that you allude to in Australia.

We simply follow the market, wherever it is, when we are a machine supplier. That is about the most direct answer I can give you from our viewpoint.

Senator DOMENICI. I understand that. You are not going to do anything illegal and nobody is asking you to be a goody-goody. I would not question it. You are saying we ought to do these things to maintain our competency in the field and our competitiveness at the same time. There appear to be some in Government who want to sell to Australia, our prime competitor in the uranium field, the most advanced technology.

So they will not only be competing in uranium but they will be competing in enrichment and, yet, we are here saying let's beef up what we have got at home so we can stay. It would appear to me at least a premise that we should stay out of that as long as possible. It would be logical, would it not?

Mr. ROWAN. One could not argue with that. I think the primary objective has to be as we have all said today, that GCEP is viable and enterprising on its own. The Australian offering of the Federal Government is hollow without GCEP. It is not there.

Senator DOMENICI. Who would be selling this technology, the Government or the private sector, if we proceed with Australia and who owns the rights to this advanced technology?

Mr. ROWAN. Perhaps, Senator, that is a question that would be better fielded by DOE people here today. My understanding of it is that most of it is Government technology, 100 percent, and it would have to be through whatever legislative arrangements are authorized or promulgated for the authorization of such technology to be transferred. It is not done unilaterally.

Senator DOMENICI. I have just a few other questions. Mr. Grant, do you know if Boeing was drawn to DOE's program in 1974 when examining the potential for the private sector enrichment? If that opportunity were offered at this time, the private sector enrichment, would you not know with much more certainty the operating performance of advanced GCEP centrifuge technology? Would there be some interest with the private ownership?

Mr. GRANT. If the Government tells us what the terms and conditions are for private ownership of the enrichment enterprise, we will be there.

Senator DOMENICI. Very interesting.

Mr. Rowan, I believe your company has participated in the advanced isotope separation program. Is that correct?

Mr. ROWAN. That is correct.

Senator DOMENICI. You are not alone. Others have also.

Mr. ROWAN. Yes, indeed.

Senator DOMENICI. Do you believe that the advanced isotope technology represents a technology which the private sector might be willing to assume the ownership and development of?

Mr. ROWAN. Indeed I do, much more so than even the centrifuging and by far greater than it would be in the case of diffusion.

Senator DOMENICI. Would you provide us for the record with some backup details as to why that statement of yours is so?

Mr. ROWAN. I think it is answered simply by comparing the magnitude of projected plant capital equipment requirements for the two processes. If you had $7 billion, current year dollars, capital cost for the $9 million or $8.8 million SWU or centrifuge plant versus, you pick the number, who knows, but it has been indicated to be anywhere between half a billion to three-quarters of a billion dollars for a comparably sized AIS plant.

Obviously, that is an easier thing to cope with, even with that sale with private industry than a number of perhaps 10 times larger. Development is a separate matter.

Mr. GRANT. May I comment briefly on that one. We have been involved in that. I will reserve my comments on what I think the capital costs on AIS are going to be until about 1989 and then I would like to come back and answer that question then.

Senator DOMENICI. Senator Ford do you have anything to add?

Senator FORD. No.

Senator DOMENICI. Thank you all very much. The subcommittee stands adjourned.

[Whereupon, at 11:45 a.m., the subcommittee was adjourned.]